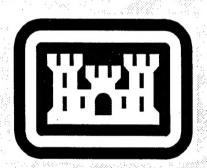
(EEAP) BOILER AND CHILLER STUDY

FORT SAM HOUSTON

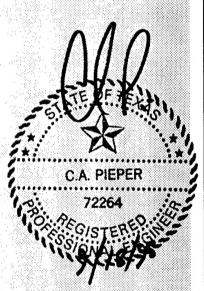
SAN ANTONIO, TEXAS

FINAL REPORT



US Army Corps of Engineers

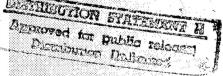
Fort Worth Division



CONDUCTED BY

HUITT-ZOLLARS, INC.

CONSULTING ENGINEERS
FORT WORTH, TEXAS



9/18/95

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DEPARTMENT OF THE ARMY

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I. EXECUTIVE SUMMARY

A. Introduction

This energy conservation study was performed by Huitt-Zollars Inc, for the U.S. Army Engineer District (USAED), Fort Worth, under contract number DACAC63-94-D-0015. The study was conducted at Fort Sam Houston (FSH) in San Antonio, Texas, between November 28, 1994 and June 15, 1995. The site survey, data collection and analysis was performed by John Carter, E.I.T, Tom Holthaus, P.E., Walter H. Williams III, P.E., and C.A. Pieper, P.E..

The purpose of the study was to perform a limited site survey of specific buildings at the facility, identify specific Energy Conservation Opportunities (ECOs) that exist, and then evaluate these ECOs for technical and economic feasibility. These ECOs were limited to central boiler and chiller plant systems serving specific building groups at FSH.

This survey was conducted with the assistance of many individuals at the FSH facility. Special thanks are extended to all of them, including the following individuals:

Gerardo De La Pena, Energy Coordinator Frank Carbonell, Engineering Service Gene Rodriguez, Engineering Service Ray Mendoza, Engineering Service Mike Brynes, Operations and Maintenance Henry Guerra, Operations and Maintenance Al Mote, Energy Program Specialist

Other individuals who assisted in this study by providing equipment and cost data are listed as follows:

Tom McGreal, York International, Dallas, TX
John Neal, Sr., Neal and Associates, Dallas, TX
Joe Scolaro and Brian Mitchell, Mitchell Technical Sales, Dallas, TX
Preston Dickson, Timberlake and Woffard, Inc., Dallas, TX
Larry Carpenter, The Trane Company, Fort Worth, TX
David Recca, DynaService, Fort Worth, TX

Any questions concerning this report should be directed to the Project Manager at Huitt-Zollars Inc., 512 Main Street, Suite 1500, Fort Worth, Texas 76102. Phone 817-335-3000.

B. Buildings Studied

This study was performed on five separate groups of buildings at the Fort Sam Houston installation in San Antonio, Tx. These groups were identified as areas 100, 900, 1300, 2200 and Quadrangle. Buildings in each of these areas are briefly described as follows:

Area 100: These twenty buildings are currently used as office buildings, barracks, and other

miscellaneous things such as a band rehearsal hall.

Area 900: These buildings consisted of sixteen barracks, four smaller support buildings and one

large administrative building, all occupied by army personnel.

Area 1300: The buildings in this group consisted of six barracks, one dining hall and one

administrative office building.

Area 2200: The four buildings in this group consisted of three barracks and one administrative

office building, which were all approximately 25 years old.

Quadrangle: The four buildings in this group are all administrative offices, one of which serves as

the headquarters of the 5th Army.

C. Present Energy Consumption

Base Year Energy Consumption: The total metered electrical and gas consumptions for 12 consecutive months, prior to this study, were obtained from the facility and are referred to as the 'base year'. These data are shown on page 12 and are summarized as follows:

Figure 1. Base Year Energy Usage By Source

ENERGY SOURCE	ANNU	COST \$	
Electricity	153,580 MWH	524,169 MMBTU	6,567,101
Natural Gas	51,415 MCF	51,415 MMBTU	192,985
Total		575,584 MMBTU	6,760,086

Boiler & Chiller Systems Energy Consumption: The annual energy consumption for the boiler & chiller systems studied was calculated in Appendix B, using the Trace 600 computer program to model the buildings and HVAC systems. This consumption amounted to a total of 11.1% of the base year energy usage and 7.4% of the energy costs. These system energy consumptions are given as follows:

Figure 2. Annual Boiler & Chiller Systems Energy Consumption

AREA	COOLING SYSTEM DEMAND \$/YR	COOLING SYSTEM ELECT. KWH/YR	COOLING SYSTEM ELECT. \$/YR	HEATING SYSTEM DEMAND \$/YR	HEATING SYSTEM ELECT. KWH/YR	HEATING SYSTEM ELECT. \$/YR	HEATING SYSTEM GAS MCF/YR	HEATING SYSTEM GAS \$/YR
100	46,621	1,687,278	35,433	1,269	89,804	1,886	1,927	5,126
900	13,242	621,339	13,048	1,000	88,213	1,852	7,809	20,771
1300	67,861	3,019,253	63,404	2,687	259,249	5,444	18,751	49,878
2200	36,390	1,609,767	33,805	797	51,536	1,082	4,949	13,163
QUAD	51,292	1,633,303	34,299	221	6,096	128	1,210	3,220
SUBTOTALS	215,405	8,570,940	179,990	5,973	494,898	10,393	34,646	92,158

ANNUAL BOILER & CHILLER SYSTEM ENERGY

63,898 MMBTU/YR

ANNUAL BOILER & CHILLER SYSTEM COST, \$/YR

503,919 \$/YR

D. Energy Conservation Opportunity (ECO) Analysis

ECOs Rejected: After reviewing the data collected at the facility and considering all of the practical limitations involved, there were no potential ECOs which were rejected prior to performing calculations. Therefore, energy savings calculations were performed for all ECOs identified in the scope of work.

ECOs Recommended: Certain ECOs which were identified during the building survey have been evaluated for technical and economic feasibility and are recommended for implementation. Complete documentation of all calculations as well as information required for implementation is included in Appendix D. These recommended ECOs are summarized in order of descending Savings to Investment Ratio (SIR) in Table 1 on page 6.

ECOs Not Recommended: Certain ECOs which were identified during the building survey have been evaluated for technical and economic feasibility but are not recommended for implementation. Complete documentation of all calculations are included in Appendix E. These non-recommended ECOs are summarized in order of order of descending SIR in Table 2 on page 6.

ECIP Projects Developed: The facility will submit three projects for ECIP funding, from the recommended ECOs shown in Table 1. The DD-1391 forms needed to request ECIP funding for each project are included in this report. These projects are listed below in order of descending SIR.

ECIP Project	Description	Cost \$	Payback yrs	SIR
1	Chiller Retrofits, Areas 2200 & 900, Boiler Retrofit, Area 1300	558,058	7.7	2.27
2	Chiller Retrofit, Area 1300	479,191	8.4	1.98
3	New Central Chiller Plant, Area 100	556,559	8.6	1.73

Non-ECIP Projects Developed: The facility will also submit all ECOs indivudually as projects for non-ECIP funding. The DD-1391 forms needed to request non-ECIP funding for each project are included in this report. These projects are listed below in order of descending SIR.

Non-ECIP Project	Description	Cost \$	Payback yrs	SIR
1	Chiller Retrofit, Area 2200	237,078	6.3	2.73
2	Chiller Retrofit, Area 900	157,256	8.9	2.08
3	Chiller Retrofit, Area 1300	479,191	8.4	1.98
4	Boiler Retrofit, Area 1300	163,724	9.6	1.79
5	New Central Chiller Plant, Area 100	556,559	8.6	1.73

Recommended Maintenance & Operations Practices: The following maintenance and operations (M&O) practices are recommended to help conserve boiler and chiller plant energy at FSH.

- 1. The Energy Coordinator and the FSH Director of Public Works should develop a master plan specification for all future central boiler and chiller plant maintenance and renovation projects. All facility project managers, as well as any central plant maintenance contractors should be required to follow this specification. The energy coordinator should review all new central boiler and chiller plant designs to check for compliance with the specifications.
- 2. The energy coordinator should attend training seminars for building energy.
- The installation should increase the size of their current maintenance staff by adding trained HVAC technicians.
- 4. The installation should provide technical training for it's current HVAC staff, especially in the area of HVAC controls.
- 5. Revise the current HVAC preventative maintenance program as needed to improve the overall condition of the existing systems and equipment. The Energy Manager should be involved in this process to ensure that energy conservation concerns are addressed.
- 6. Add status, alarm, start and stop capabilities for all central boiler and chiller systems and auxiliaries to the post's existing building automation system. This will allow the maintenance staff to have better monitoring and control capabilities than they currently have.
- 7. Repair or replace all building HVAC control systems to improve space temperature control and conserve heating and cooling system energy.

E. Energy And Cost Savings

Total Potential Energy and Cost Savings. The energy and cost savings from the implementation of all ECIP projects was calculated as follows:

Electrical Energy Savings	8,690	MMBTU/yr
Electrical Demand Savings	49,884	\$/yr
Gas Energy Savings	4,020	MMBTU/yr
Total Energy Savings	12,710	MMBTU/yr
Total Cost Savings	193,496	\$/yr
Total Investment	1,593,808	\$
Simple Payback	8.2	yrs

Energy Use and Costs Before and After. Based on the base year electrical and gas energy consumptions and costs shown on page 12, and the calculated total potential savings above, the FSH energy and usage and costs before and after implementation of the 3 Non-ECIP projects is as follows:

	<u>Before</u>	<u>After</u>
Electrical	153,580 MWH	151,033 MWH
Gas	51,415 MCF	47,395 MCF
Total Cost	6,760,086\$	6,566,590 \$

Percentage Saved. Based on the base year electrical and gas energy consumptions and costs, the percentage of savings from the 3 projects is as follows:

Electrical Energy Saved =
$$\left[\frac{2,546 \text{ MWH}}{153,580 \text{ MWH}}\right]$$
 = 1.6%
Gas Energy Savings = $\left[\frac{4,020 \text{ MCF}}{51,415 \text{ MCF}}\right]$ = 7.8%

Energy Cost Savings =
$$\left[\frac{193,496 \$}{6,760,086 \$}\right] = 2.8\%$$

	SIR	2.73	2.08		1.98	1.79		1.73	
NDED	Simple Payback Yrs	6.3	8.9		4.8	9.6		8.6	8.2
OMME	Total Investment \$	237,078	157 256		479,191	163,724		556,559	1,593,808
)s) REC	Total Cost Savings \$/yr	37,433	17.650		56,936	17,012		64,465	193,496
ES (ECC	Total Energy Savings MMBTU/yr	1,304	434		3,424	4,732		2,816	12,710
TUNITIE	Gas Energy Savings MMBTU/yr	0	C		0	4,020		0	4,020
OPPOR	Electrical Demand Savings \$/yr	11,822	2 520		13,914	1,847		19,781	49,884
ATION	Electrical Energy Savings MMBTU/yr	1,304	757		3,424	712		2,816	8,690
TABLE 1. ENERGY CONSERVATION OPPORTUNITIES (ECOs) RECOMMENDED	Description	AREA 2200 Replace Existing Chiller With New Centrifugal Chiller	AREA 900	AREA 1300	Replace Existing Chillers With Centrifugal Chillers AREA 1300	Replace Existing Boilers With High % Modular Boilers	AREA 100	Replace Individual Chillers With Central Chiller Plant	Totals
	ECO	ш	1		O	۵		_	

\sim	SIR	5	ij		0.71		0.69		99.0		0.20	
Ħ.			<u>.</u>									2
MEN	Simple Payback Yrs	ţ	2		20.9		25.8		23.8		71.2	11.2
ECOM	Total Investment \$	01	180,00		824,178		78,553		273,951		394,910	4,415,465
NOTR	Total Cost Savings \$/yr	000	2,203		39,257		3,037		11,483		5,542	394,513
(ECOs)	Total Energy Savings MMBTU/yr		007'1	0	2,212	0	948	0	998		446	28,497
NITIES	Gas Energy Savings MMBTU/yr	J ()	1,233		0		910		089		434	10,431
PORTU	Electrical Demand Savings \$/yr		٥		14,116		378		680		122	100,722
ION OP	Electrical Energy Savings MMBTU/yr	·	D		2,212		38		186		-12	18,066
TABLE 2. ENERGY CONSERVATION OPPORTUNITIES (ECOS) NOT RECOMMENDED	Description		Replace Existing Boilers With High % Modular Bollers	QUADRANGLE AREA	Replace Existing Chillers With Central Chiller Plant	AREA 2200	Replace Existing Boilers With High % Modular Boilers	AREA 100	Replace Existing Boilers With Central Boiler Plant	QUADRANGLE AREA	Replace Existing Boilers With Central Boiler Plant	Totals
1	ECO	-	В		O		L.		7		r	

II. NARRATIVE REPORT

A. Entry Interview

Work Plan: An entry interview meeting was conducted at the Fort Sam Houston (FSH) facility on October 27, 1994. Present at the meeting were representatives of Huitt Zollars Inc. (HZ), Tom Holthaus, P.E., Project Manager, and Walter H. Williams III, P.E., Mechanical Engineer, as well as representatives from FSH, Gerardo De La Pena, Energy Coordinator and others. At that time, a description of the work plan for this study was presented. The work plan was a summary of the individual tasks to be performed to complete the boiler & chiller study and the approximate date that each task was to begin. Each step of the work plan

Figure 3. Work Plan

	S722462.465278
10/3/94	Entry Interview
10/3/94	Building & Systems Data Collection
10/10/95	Formulate ECOs & Perform Calculations
6/15/95	Interim Findings Submittal
9/18/95	Pre-Final Report Submittal
10/30/95	Final Report Submittal

was described in detail to the FSH staff. The work plan is shown in Figure 3.

Data List: After discussing the work plan, the FSH staff was presented a list of data items to be collected by the study team, shown in Figure 4. This list was a summary of the information required by the surveyors. The study team and FSH staff discussed the methods by which all of the data on the list were to be obtained. The data concerning the existing boiler and chiller systems were to be collected from the buildings and recorded onto preprinted data forms. Building mechanical drawings were to be collected, information extracted and included on individual building data forms. All data forms are included in Appendix C. The FSH personnel provided direction as to where to obtain information on the list. They also provided useful information on past energy conservation efforts,

Figure 4. Data Acquisition List

- 1. Existing central boiler and chiller systems.
- 2. Existing auxiliary systems in central plants.
- 3. Building HVAC system types and operational hours.
- 4. Building size, age and remaining useful life.
- 5. Existing building operational schedules and area usage.
- 6. Facility electricity, gas, other utility rates
- 7. Facility electricity, gas, other utility consumptions.
- 8. Utility company rebate programs.
- 9. Past boiler and chiller energy conservation projects.
- 10. Proposed boiler and chiller energy conservation projects.
- 11. Typical boiler and chiller maintenance procedures and costs.
- 12. Typical boiler and chiller retrofit procedures.

as well as any ongoing or future planned energy conservation measures. One such project underway is the installation of a base wide building automation system, to control primary and secondary HVAC equipment in many buildings on the post.

ECO List: Following the discussion on the data list, the FSH personnel were presented a list of specific Energy Conservation Opportunities (ECOs) that were identified for evaluation in the Detailed Scope of Work (see pages F-11 through F-15). This list is shown in Figure 5. The first ECO specified was the upgrade or replacement of existing central chillers with more efficient systems. The scope specifically called for the evaluation of electric centrifugal chillers, electric centrifugals with variable frequency drives, electric screw chillers and gas driven centrifugal chillers. All of these types were evaluated as a means of saving energy and maintenance costs in the existing central chiller plants of areas 900, 1300 and 2200. The second ECO specified was the upgrade or replacement of existing central boilers with

more efficient systems. Since no specific types were identified, the most efficient alternatives were selected and evaluated as a means of saving energy and maintenance costs in the existing central boiler plants of areas 900, 1300 and 2200. The third ECO specified was the installation of new central chiller plants to replace the existing individual building chillers in areas 100 and the Quadrangle. These new central plant evaluations were similar to a 1986 central plant design for area 100 which was never implemented. The fourth

Figure 5. Specific ECOs List

- 1. Chiller replacement or retrofit.
- 2. Boiler upgrade or replacement.
- 3. Install central chiller plants.
- 4. Install central boiler plants.

ECO specified was the installation of new central boiler plants to replace the existing individual building boilers in areas 100 and the Quadrangle. In all ECOs, the annual energy consumption of the boilers, chillers and auxiliary equipment were calculated by computer simulations using the Trane Trace 600 program. Building data were used to accurately model each building such that a realistic load profile was created for simulating boiler and chiller operational patterns. In all ECO calculations, the required capacity of the existing central heating and cooling equipment was evaluated from the computer simulations and recommendations for proper sizing were made.

B. Data Collection

Following the entry interview, the study team began the task of collecting the required data. First, building mechanical plans were studied and data was extracted. Then field surveys were made on all of the buildings in the study to verify and supplement data collected from the drawings. All of the data obtained from drawings and field survey were put onto data sheets and included in Appendix C. The following summarizes the data collection phase of this study.

Building Data: This study was performed on five separate groups of buildings and required two separate site visits to collect data. These groups were identified as areas 100, 900, 1300, 2200 and Quadrangle. Buildings in each of these areas are described as follows:

- 1. Area 900 This area included buildings 902, 904, 905, 906, 907, 908, 915, 916, 917, 919, 920, 921, 922, 924, 925, 926, 928, 929, 930, 931 and 932. A map of this area is included in Appendix C along with the data sheets for these buildings. The buildings in this group were constructed approximately 21 years ago and are mainly steel and concrete structures with brick veneer exteriors and flat built-up roofs. These buildings consisted of 16 barracks, four smaller support buildings and one large administrative building, all occupied by army personnel. All of the barracks were three story structures while the others were single story structures.
- 2. Area 1300 This area included buildings 1350, 1374, 1375, 1377, 1379, 1380, 1382 and 1385. A map of this area is included in Appendix C along with the data sheets for these buildings. The buildings in this group consisted of six barracks, one dining hall and one administrative office building. All buildings are approximately 24 years old except for 1350, which is only 12 years old. These buildings were all occupied by army personnel. All of these buildings are mainly steel and concrete structures with brick veneer exteriors and flat built-up roofs. All of the barracks were multi-story structures while the others were single story structures.
- 3. Area 2200 This area included buildings 2263, 2264, 2265 and 2266. A map of this area is included in Appendix C along with the data sheets for these buildings. The buildings in this group consisted of three barracks and one administrative office building, which were all approximately 25 years old. These buildings were all occupied by regular army personnel. All of these buildings are mainly masonry structures with stucco exteriors and pitched red clay tile roofs. All of the buildings were three story structures with both attic and basement spaces. One

of the barracks buildings has a dining hall, while another has a museum.

- 4. Quadrangle This area included buildings 16, 44, 56 and 4015. A map of this area is included in Appendix C along with the data sheets for these buildings. The four buildings in this group are all administrative offices, one of which serves as the headquarters of the 5th Army. All but one are multi-story, with construction ranging from wood frame and siding with pitched shingle roofs to masonry structure, limestone exterior and pitched metal roof on the Headquarters building. These buildings are between 40 and 45 years old, and are considered historically significant.
- <u>Area 100</u> This area included buildings 122, 124, 125, 127, 128, 132, 133, 134, 135, 142, 143, 144, 145, 146, 147, 149, 197, 198, 199 and 250. A map of this area is included in Appendix C along with the data sheets for these buildings. The buildings in this group were constructed approximately 50 to 55 years ago and are mainly wood framed structures with brick veneer exteriors and pitched shingle roofs. Most all of these buildings were two story structures that had basement and attic spaces. These buildings are currently used as office buildings, barracks, and other miscellaneous things such as a band rehearsal hall. These buildings are occupied by both army and civilian personnel.

Central Plant & HVAC Systems Data:

1. Area 900 - The buildings in this area are served by a central plant in building 902. The primary cooling system consists of a single 300 ton, centrifugal, water cooled chiller which is ten years old and uses R-11 refrigerant. A sixteen year old packaged, single cell crossflow cooling tower serves the chiller. Both the chiller and cooling tower appear to be in fair condition with many years of useful life remaining. The computer simulations of this area verified that the installed tonnage was both adequate and required to meet the building cooling loads.

Primary heating systems consist of three gas fired, water tube, HW boilers. The combined output capacity of these sixteen year old boilers is approximately 4,995 MBH, and they appeared to be in fair condition with a few years of useful life remaining. The computer simulations of this area identified that the installed capacity was approximately 2 ½ times what is required to adequately meet the building heating loads.

The individual chilled water (CHW) and condenser water (CND) pumps and multiple heating water (HW) pumps are located within the plant. These primary systems distribute thermal energy to the buildings through a four-pipe distribution loop. The domestic hot water (DHW) for the area is generated in the buildings through individual shell and tube heat exchangers in mechanical rooms, using HW from the boilers. A single DHW circulation pump for buildings distributes the DHW to the plumbing fixtures. This design requires a boiler to operate year round to produce DHW. The other buildings have individual gas fired water heaters.

Secondary HVAC systems in these buildings consist of two pipe fan coil units (FCUs) in the barracks, while multizone (MZ) and single zone (SZ) air handling units are located within the support and administrative buildings. Each pair of barracks buildings has a secondary pump to circulate HW or CHW from the central loop to all the FCUs. Overall HVAC system performance in this area is poor due in part to faulty or inadequate system controls, making space temperatures difficult to maintain. Also, the two-pipe distribution loops in the buildings and the four-pipe distribution loop from the central plant to the buildings are in poor condition with corrosion, leaks and missing or unserviceable insulation.

2. Area 1300 - The buildings in this area are served by a central plant in the dining hall building 1377. The primary cooling systems consist of two centrifugal water cooled chillers, rated at a combined 1200 tons, which are 23 years old and use R-11 refrigerant. These two chillers are piped in series and serve all of the buildings except for 1350. This newer building is served by a single 438 ton, water cooled centrifugal chiller that is 12 years old and uses R-11 refrigerant. A twelve year old, single cell cooling tower serves this chiller while a 23 year old, two cell tower serves the other two chillers. The older chillers and tower appeared to be in poor condition and nearing the end of useful life. The newer chiller and tower were in fair condition with some years of useful life remaining. The computer simulations of this area identified that the installed capacity of 1,424 tons was around 14% higher than what is required to meet the building cooling loads.

The primary heating systems consisted of two firetube, HW boilers which are 23 years old and have a combined output capacity of 11,824 MBH. These two boilers serve all of the buildings except for 1350. This building is served by two watertube, HW boilers which are 12 years old and have a combined output capacity of 9,653 MBH. The older boilers appeared to be in poor condition and are near the end of their useful life. The newest boiler was in fair condition with some years of useful life remaining. The computer simulations of this area identified that the installed capacity of 21,477 MBH was approximately 3 times what is required to adequately meet the building heating loads.

The three CHW pumps, three CND pumps and three HW pumps are located within the plant in building 1377. These primary systems distribute thermal energy to the buildings through two four-pipe distribution loops, which appeared to be in good condition. One loop is for building 1350 and the other is for all other buildings in the area. DHW is generated by individual gas fired water heaters in each building.

Secondary HVAC systems in these buildings consist of some two pipe FCUs and SZ air handlers, and many four pipe MZ air handling units located within the buildings. Each building has secondary CHW and HW pumps to circulate water from the central loops to all the FCUs and air handlers. Overall HVAC system performance in this area is poor due in part to faulty or inadequate controls, making space temperatures difficult to maintain.

3. Area 2200 - The buildings in this area are served by a central CHW plant in the basement of building 2265. The primary cooling system consists of a single 650 ton centrifugal, water cooled chiller, which is 22 years old and uses R-11 refrigerant. A 23 year old, single cell, built-up cooling tower is outside to serve the chiller. The chiller and tower appear to be in poor condition and nearing the end of useful service. The computer simulations of this area identified that the installed capacity was around 18% higher than what is required to meet the building cooling loads.

The primary heating systems consist of three watertube, HW boilers which are seven years old and have a combined rated capacity of 6,720 MBH. These boilers are all located in a separate mechanical building behind 2265 and appeared to be in good condition with many years of useful life remaining. The computer simulations of this area identified that the installed capacity was approximately 2 ½ times what is required to adequately meet the building heating loads.

A single CHW pump, CND pump and three HW pumps are located within the plants. These primary systems distribute thermal energy to the 2200 area buildings through a four-pipe distribution loop which appears to be in good condition. DHW is generated by individual gas fired water heaters in each building.

Secondary HVAC systems in these buildings consist of SZ and MZ air handlers located within the buildings. Each building has secondary CHW and HW pumps to circulate water from the central loop to all the FCUs and air handlers. Overall HVAC system performance in this area is poor due in part to faulty or inadequate controls, making space temperatures difficult to maintain.

4. Quadrangle - The buildings in this area have no central boiler or chiller plant. All buildings have stand alone primary heating and cooling systems. The primary cooling systems consisted of one 12 year old, air cooled, reciprocating chiller, rated at 50 tons and serving building 4015. This chiller appears to be in fair condition with at least 10 years of useful life remaining. Another two year old, air cooled, reciprocating chiller, rated at 30 tons serves building 56. This chiller appears to be in good condition with many years of useful life remaining. Building 16 is served by two air cooled, reciprocating chillers. One is only a year old and is rated at 120 tons. The other is eight years old and is rated at 110 tons. Both of these chillers appeared to be in good condition with many years of useful life remaining. Finally, building 44 is served by three chillers which are 10 years old and rated at a combined 225 tons. All three of these chillers appeared to be in good condition with many years of useful life remaining. All of these chillers operate on the R-22 refrigerant. The computer simulations of this area verified that the installed capacity of 565 tons was both adequate and required to meet the building cooling loads. However in some areas, especially in building 44, temperature control problems are apparent.

The primary heating systems consist of an eight year old, firetube HW boiler, with an output rating of 741 MBH, serving building 4015. This boiler appeared to be in good condition with many years of useful life remaining. Building 16 has two watertube, steam boilers which are 16 years old. One is rated at 1,614 MBH output and serves approximately half of the building. The other is rated at 3,587 MBH output and serves the other half of building 16 as well as all of building 56. These two boilers appeared to be in fair condition with some useful life remaining. Building 44 has 12 modular steam boilers which are 25 years old and have a combined output of 3,028 MBH. These boilers appeared to be in poor condition and are at the end of their useful life. The computer simulations of this area identified that the installed capacity was approximately 2 ½ times what is required to adequately meet the building heating loads.

The CHW pumps for all the chillers in the Quadrangle area are located within the buildings they serve. A single HW pump is located within building 4015 to circulate water through the buildings secondary systems. All other buildings have steam and condensate return piping from the boilers to all secondary systems. DHW is generated by individual gas fired water heaters in each building.

Secondary HVAC systems in the Quadrangle area buildings consist of dual duct, MZ and SZ air handling units as well as FCUs located in some areas of the buildings. These units all have steam coils for heat, except for those in building 4015, which have hot water coils. Some areas of building 16 and building 44 are cooled by direct expansion (DX) terminal units, with small cooling towers outside for condensers. Overall HVAC system performance in this area is poor due in part to faulty or inadequate controls, making space temperatures difficult to maintain. Because of the historical significance of this area, there is little space for a central plant. However, one could be located nearby with a historically correct wall built around it to hide the equipment.

5. <u>Area 100</u> - The buildings in this area have no central boiler or chiller plant. All buildings have stand alone primary heating and cooling systems. The primary cooling systems consist of 14

air cooled, reciprocating chillers, which are all ten years old and have a combined capacity of 540 tons. All chillers appeared to be in good condition with many years of useful life remaining. The computer simulations of this area identified that the installed capacity of 540 tons was around 28% higher than what is required to meet the building cooling loads.

The primary heating systems consisted of 14 watertube, HW boilers, which are all ten years old and have a combined capacity of 8,829 MBH. All boilers appeared to be in good condition with many years of useful life remaining. The computer simulations of this area identified that the installed capacity was approximately 4 ½ times what is required to adequately meet the building heating loads.

CHW and HW pumps are generally located within the buildings that they serve. DHW is generated by individual gas fired water heaters in each basement.

Secondary HVAC systems in these buildings consist of MZ and SZ air handling units located within the buildings. However, one building has window A/C units, a gas fired warm air furnace, and no boiler or chiller. Overall HVAC system performance in this area is poor due in part to faulty or inadequate controls, making space temperatures difficult to maintain.

Maintenance Data: Most HVAC system maintenance is performed by post civil service personnel, who maintain the central plants as well as building systems. In general, post maintenance is inadequate due to cutbacks in manpower, in conjunction with the addition of new buildings to maintain. For instance, some HVAC air filters appeared to be excessively dirty, and leaks were found in the HW coil of one air handler during data collection. Also, HVAC system controls appeared to be inoperable or missing, adding to the inability of the systems to maintain temperatures within the building spaces. Repair or replacement of these controls could save heating and cooling energy, but is beyond the scope of this study. In some buildings the outside air intakes to air handlers were blocked off with sheet metal. The existing preventative maintenance program is less effective than could be desired.

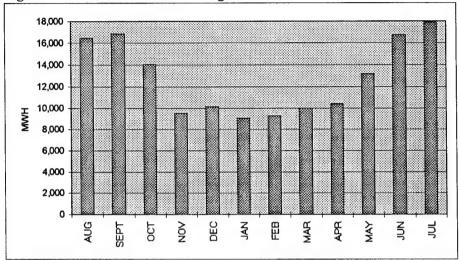
Utility Data: A 12 month utility billing history was obtained from the energy coordinator which covered the period from August, 1993 through July, 1994. This history included all of the metered electric consumption for the installation and gas consumption for only the FSH areas included in this study. This history is shown in Figure 6. The total cost of electricity for the base year was \$6.5 million and the total cost for gas was \$0.19 million.

Figure 6. 1993-94 Base Year Utility Data

Billing		Electrical	Natura	l Gas	
Period	Demand	Consumption	Cost	Consumption	Cost
	KW	MWH	\$\$	MCF	\$
AUG	30,576	16,464	785,463	1,826.4	7,880.0
SEPT	31,024	16,856	795,130	1,750.2	7,161.0
ост	30,240	14,084	706,204	1,679.9	6,508.0
NOV	27,496	9,548	464,806	6,988.7	23,429.0
DEC	24,819	10,136	464,187	5,423.0	20,105.0
JAN	24,819	9,044	379,870	10,451.3	37,106.0
FEB	24,819	9,268	391,687	9,341.3	33,138.0
MAR	24,819	9,968	459,976	6,816.0	26,047.0
APR	24,819	10,416	376,714	2,177.0	9,736.0
MAY	27,160	13,216	447,478	1,750.6	7,774.0
JUN	31,752	16,716	620,912	1,519.0	6,600.0
JUL	32,872	17,864	674,674	1,691.1	7,501.0
Total	335,215	153,580	6,567,101	51,414.5	192,985

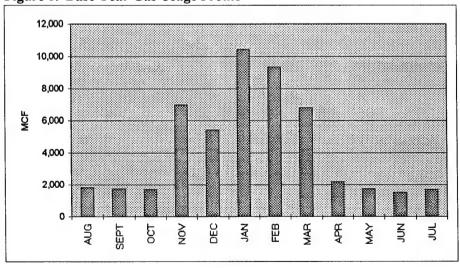
Charts of the base year energy usages were plotted and are shown in Figures 7 and 8. These charts give a visual representation of the installation's energy usage patterns for the year. Looking at Figure 7, it can be seen that the electrical usage never falls below 9,000 MWH per month. This is considered a 'baseline' of electrical energy use. It can be assumed that all energy usage above this baseline is consumed by cooling systems, based on the peaks and the months in which they occur.





Simular observations can be made about gas energy usage, shown in Figure 8. The baseline usage here is around 1,800 MCF of gas per month. Since gas is the primary source of heating at FSH, the obvious peak during the winter months can be considered heating energy. Therefore, all gas energy usage below the baseline is used for DHW and cooking equipment. This is a large amount of energy usage and should be considered a large target for potential energy savings.

Figure 8. Base Year Gas Usage Profile



Based on the current gas and electric utility rates from the City Public Service (CPS) of San Antonio, the current avoided costs for electrical savings are \$0.021 per KWH, and \$7.50 to \$10.00 per KW demand savings, depending upon the time of year. For natural gas savings in area 100 only, the avoided cost is \$4.39 per MCF. For all other areas, the avoided cost of gas savings is \$2.66 per MCF. There are currently no rebates available from the CPS for boiler or chiller energy conservation projects.

Replacement Boiler Selection: Data on available replacement boilers were obtained from typical manufacturers in order to select representative boilers for ECO evaluations. This data included performance characteristics, physical dimensions and cost figures. The criteria for selecting new boiler systems for the ECOs are described below.

- 1. <u>Efficiency</u>. Replacement boilers that had the highest overall efficiency over the operating range were selected in each area. In most cases, this criteria was met by the high-efficiency modular boilers which were modeled in the ECOs. These are fully condensing, forced draft firetube units that have efficiencies in the 90s over the entire range of operation. No other boiler type was found to match this performance.
- 2. <u>Turn-down ratio</u>. In order to limit the thermal shock and efficiency losses associated with cycling, replacement boilers for the ECOs needed to have a high turn-down ratio. The 14:1 ratio associated with the modular boilers used in most ECOs was as good or better than other available boilers with lower efficiencies. And the modular concept of using multiple boilers to match the heating loads, combined with this high turn-down ratio, minimizes the negative impacts of cycling.
- 3. <u>Controls.</u> In order to closely match the heating load requirements at any given time, all new boilers were selected with fully modulating controls. Two-position or multi-stage controls would increase the possibility of boiler cycling, as well as reduce the part load efficiency.
- 4. <u>Physical size</u>. In order to fit the new boilers into the buildings without modifying the existing boiler room openings, the small footprint and overall size of the modular boilers was the best choice for the ECOs. Other types of boilers were larger and would require more effort and cost to install in the buildings. This criteria was not a factor in areas 100 and the Quadrangle, where completely new central boiler plants were being considered.
- 5. <u>First cost</u>. The first cost of the modular boilers was greater than other types available. However, the efficiency improvements of these units justified the higher initial first costs in the Life Cycle Cost Analysis. In areas 100 and the Quadrangle, the first cost of the boilers selected was equivalent to or lower than most of the other boiler types available for the ECOs.
- 6. <u>Maintenance requirements and costs.</u> All types of replacement boilers would require annual cleaning of the heat exchanger surfaces, as well as optimization of the combustion systems. The boilers used in the ECOs appeared to be as good or better than all other boiler types in ease of maintenance. This is due to their small physical size and construction features. Maintenance cost estimates obtained from the local contractor were independent of boiler type. Therefore, all new boiler types available were assumed to be approximately equal in the area of maintenance costs.

Replacement Chiller Selection: Data on available replacement chillers were obtained from typical manufacturers in order to select representative chillers for ECO evaluations. This data included performance characteristics, physical dimensions and cost figures. The criteria for selecting new chiller systems for the ECOs are described below.

1. <u>Manufacturer</u>. The facility maintenance personnel requested that York chillers be used in this study as they preferred them to other manufacturer's products. Therefore, most new chillers used for analysis in the ECOs were made by York. In areas 100 and the Quadrangle, McQuay chillers were selected for reasons mentioned in the following text.

- 2. Machine Type. The scope of work generally identified the specific types of chillers to be compared in each area. These were the centrifugal, centrifugal with variable speed drive, screw and gas-engine driven centrifugal. Therefore, all four of these chiller types were compared in each ECO to determine the most economically beneficial retrofit for each area. In areas 100 and the Quadrangle, where new central plants were under consideration, only packaged air-cooled type chillers were considered. This was done to minimize the implementation costs in these areas.
- <u>Drive configuration</u>. The new machines selected for ECO analysis all had open drives on the compressors. This increases the first cost somewhat, but decreases the long term maintenance costs.
- 4. <u>Refrigerant</u>. Replacement chillers were to all use either R-123 or R-134 refrigerant, as per the scope of work. This requirement was met in the study.
- 5. <u>Efficiency</u>. The full and part load efficiencies for all machines selected for evaluation were used in the ECOs. The relative effects of these efficiency differences are illustrated in the Life Cycle Cost Analysis of each machine. In areas 100 and the Quadrangle, the most efficient type of air cooled packaged chiller found was the single-screw unit from McQuay. Therefore, this machine was used in the ECO evaluations.
- First cost. The first cost data for all machines selected for evaluation were used in the ECOs.
 The relative effects of these cost differences are illustrated in the Life Cycle Cost Analysis of each machine.
- Maintenance requirements and costs. All types of replacement chillers would require periodic cleaning of the heat exchanger surfaces, as well as optimization of the compressor systems and controls. Maintenance cost estimates obtained from the local contractor were independent of chiller type. Therefore, all new chiller types available were assumed to be approximately equal in the area of maintenance costs.

C. Plan To Implement Projects:

The analysis of all potential boiler & chiller ECOs at the facility has been completed and the grouping of individual ECOs into projects has been determined. These were detailed previously in the Executive Summary. Below is an abbreviated plan for implementation of the recommended projects.

Funding: The forms DD-1391 and life cycle cost analysis summary sheets for all three ECIP projects are provided on pages 17 to 27. These are to be submitted for project funding, along with the savings calculations and cost estimates in Appendix D. Check for the latest ECIP project documentation requirements prior to submitting these forms. The forms DD-1391 and life cycle cost analysis summary sheets for all five Non-ECIP projects are provided on pages 28 to 42. These are to be submitted for project funding, along with the savings calculations and cost estimates in Appendix D if required. Check for the particular project documentation requirements prior to submitting these forms.

Programming: An engineering design firm should be selected to produce construction contract drawings and specifications for all of the projects which are funded either through ECIP or by other means. All of the savings calculations and cost estimates for the recommended ECOs in Appendix D should be supplied to the designers in order to inform them of the intent and projected budget of each ECO. The designers should use the equipment sizing described in the ECOs as a guide only, and perform all calculations necessary to properly size all new equipment. These calculations should take into consideration all existing field conditions in the areas effected by the ECOs. It is recommended that

existing auxiliary equipment be reused wherever possible to reduce the first cost of each project. The designer should field verify the condition of all existing equipment before specifying it's disposition. In the case of boiler retrofits, the designer should consider keeping some of the existing boilers in place to be as backups. Where equipment is to be removed, the specifications should include some provisions dealing with the possible salvage value of this equipment. The facility's project manager should ensure that all new central plant designs produced by the design firm do conform with the intent of each ECO, in order to realize the estimated savings. All construction drawings and specifications should be compared to the original ECOs to ensure compliance, prior to releasing for bids.

Construction: Once the plans and specifications have been reviewed and approved, the facility's project manager should release them for bids, using their normal construction procurement proceedings. Care should be taken to schedule all work at a time which would minimize the negative impact of projects on the buildings served by the central plant equipment. Prior to construction, the facility should review all shop drawings and Submittals to once again ensure compliance with the original intent of each ECO.

1. COMPONENT ARMY								
3. INSTALLATION AND LOCATION FORT SAM HOL	N ISTON, SAN ANTONIO	, TX.	4. PRO	UECT TIT		CIP		
5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJEC	Т НИМВІ	ER	8. PROJECT	cost (\$000) 558.0		
		9. COST ESTIMA	TES					
	ITEM			U/M	QUANTITY	UNIT COST	COST (\$000)	
Replace existing chille building 2265.	r with new centrifugal	chiller in		EΑ	1	237.0	237.0	
Replace existing chille 902.	er with new screw chille	er in building		EA	1	157.0	157.0	
Replace existing boile boilers in Area buildin	-	ency modula	r	EA	1	164.0	164.0	
ESTIMATED CONTRA CONTINGENCY (0%) SIOH DESIGN	CT COST						500.501 0.0 27.527 30.030	
TOTAL REQUEST							558.058	
TOTAL REQUEST (RC	OUNDED)						558.000	

10. DESCRIPTION OF PROPOSED CONSTRUCTION

AREA 2200:

Remove the existing 675 ton, R-11 centrifugal chiller in building 2265 and replace it with a 555 ton, R-134a centrifugal chiller. The existing 100 HP chilled water (CHW) pump, 50 HP condenser water (CND) pump and 40 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

AREA 900:

Remove the existing 300 ton, R-11 centrifugal chiller in building 902 and replace it with a 300 ton, R-134a screw chiller. The existing 25 HP chilled water (CHW) pump, 15 HP condenser water (CND) pump and 15 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION	ON PROJECT DATA	2. DATE 8/24/95
3. INSTALLATION AND LO FORT SAM HOUS	CATION STON, SAN ANTONIO, TX.		
4. PROJECT TITLE ECIP		5. PROJECT NUMBE	R

the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

AREA 1300:

Remove the two existing watertube boilers and single 40 HP heating water (HW) distribution pump in building 1377, which are serving building 1350. Also remove the two existing firetube boilers and the two 15 HP distribution pumps in building 1377 which serve buildings 1374, 1375, 1379, 1380, 1382, 1377 and 1385. Connect the two separate distribution loops together in building 1377 with new HW supply and return headers to make a single HW distribution system. Install four new modular high efficiency boilers, rated at 1,830 MBH output each and four new 7 ½ HP distribution pumps to serve this single system. The existing electrical service and controls should be reused as much as possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. The boilers and pumps should be sequenced to operate only as needed to maintain the supply water temperature setpoint of approximately 180 F. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and pumps, and installation of the new boilers, pumps, associated wiring and controls.

ENERGY SAVINGS

This project is required to reduce the cooling energy consumption in the 2200 and 900 area central plants, and the heating energy consumption in the 1300 area central plant. The project provides new, more efficient primary cooling and heating systems, which will save cooling and heating energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this new primary equipment will result in the following:

Electrical Energy Savings	2,450	MMBTU/yr
Electrical Demand Savings	16,189	\$/yr
Gas Energy Savings	4,020	MMBTU/yr
Total Energy Savings	6,470	MMBTU/yr
Total Cost Savings	72,094	\$/yr
Total Investment	558,058	\$
Simple Payback	7.7	yrs
SIR	2.27	

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCT	ION PROJECT DATA	2. DATE 8/24/95
3. INSTALLATION AND LO FORT SAM HOUS	CATION STON, SAN ANTONIO, TX.		
4. PROJECT TITLE ECIP		5. PROJECT NUME	BER

CURRENT SITUATION:

AREA 2200:

The existing water cooled, centrifugal chiller was installed in 1973 and serves as the primary cooling system for the four large buildings in the 2200 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the machine is already 22 years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that an electric centrifugal chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 657 tons is more than what is required to adequately cool the buildings. Therefore, the new chiller should only be sized for 555 tons to more closely match the cooling load of the four buildings.

AREA 900:

The existing water cooled, centrifugal chiller was installed in 1985 and serves as the primary cooling system for the 21 buildings in the 900 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the machine is already ten years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a dual screw chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 300 tons is required to adequately cool the buildings. Therefore, no increase or decrease in the current chiller capacity is recommended at this time.

AREA 1300:

The two existing watertube boilers serving building 1350 were installed in 1983 and are rated at 5,317 MBH and 4,336 MBH output capacity. The single 40 HP pump circulates HW from these boilers through building 1350. The two existing firetube boilers serving the other buildings in the 1300 area were installed in 1972 and are rated at 5,912 MBH output capacity each. Two 15 HP pumps circulate HW from these boilers to the seven other buildings listed above. All these boilers appear to be in fair condition. Computer simulations of the eight buildings served by these boilers determined that the current combined capacity of 21,477 MBH is about three times the amount required to adequately heat the buildings. The existing boilers are therefore

DD 1 DEC 76 1391

PAGE NO. 3 OF 4

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJEC	7 DATA 2. DATE 8/24/95			
3. INSTALLATION AND LOCATION FORT SAM HOUSTON, SAN ANTONIO, TX.					
4. PROJECT TITLE ECIP		5. PROJECT NUMBER			

operating at an inefficient, low load condition most of the time. Also, because of the constant flow rate requirements of the large boilers, excessive pumping energy is expended. By combining the two distribution systems together and staging four new high efficiency modular boilers to operate only as needed, a substantial energy savings can be realized. Also, a decrease in the combined boiler output capacity to 7,320 MBH is recommended to more closely match the heating load in the eight buildings and reduce the associated pumping energy consumption.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling and heating energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECIP-3 08-24-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER ANALYSIS DATE: 1. INVESTMENT A. CONSTRUCTION COST 500501. \$ B. SIOH 27527. C. DESIGN COST 30030. D. TOTAL COST (1A+1B+1C) \$ 558058. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE G. TOTAL INVESTMENT (1D - 1E - 1F) 558058. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED \$/MBTU(1) FUEL MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS (5) A. ELECT \$ 6.28 2450. 15386. 15.08 232021. B. DIST \$.00 0. 18.57 0. 0. .00 C. RESID \$ 0. 0. 21.02 0. 0. 10693. 4020. 0. 0. 18.58 D. NAT G \$ 2.66 198680. E. COAL .00 0. 16.83 0. F. PPG \$.00 17.38 0. \$ 16189. M. DEMAND SAVINGS 240892. 14.88 6470. \$ 42268. N. TOTAL 671593. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED TTEM COST(-) OC FACTR SAVINGS(+)/ (2) (1) (3) COST(-)(4)1. REFRIG. UPGRADE \$ 596520. 0 596520. 1.00 d. TOTAL \$ 596520. 596520. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 596520. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 72094. 7.74 YEARS 5. SIMPLE PAYBACK PERIOD (1G/4) 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1268113. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =2.27 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):

7.32 %

1. COMPONENT								2. D	ATE
ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA					8/24/95			
				T					
3. INSTALLATION AND LO		TON CAN ANTONIO	77/	4. PR(DECT TI		מור		
FURI SAM	HUUS	TON, SAN ANTONIO	, IX.			EC	CIP		
5. PROGRAM ELEMENT		6. CATAGORY CODE	7. PROJE	CT NUMB	ER	8. PROJECT	COST (\$	000)	
							4	79.C)
			9. COST ESTIM	ATES			,		
		ІТЕМ			U/M	QUANTITY	UNIT CO	OST	COST (\$000)
Replace two (2) e	xistiną	g chillers in building	1377 with o	ne	EA	1	479	.0	479.0
(1) new chiller.									
							1		
ESTIMATED CON	TRACT	COST							429.768
CONTINGENCY (C									0.0
SIOH	, 10)								23.673
DESIGN									
DESIGN									25.786
TOTAL PROUEST									470 404
TOTAL REQUEST									479.191
TOTAL REQUEST	(ROLL	NDED)							479.000
IOTAL KLOULST	וטטאן	NULUJ							473.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the two 600 ton, R-11 centrifugal chillers in building 1377 which were installed in 1972, and replace them with one R-134 centrifugal chiller, rated at 827 tons. The two existing chilled water pumps and condenser water pumps serving the existing chillers should be removed. Install a new chilled water pump and a new condenser water pump, each rated at 75 HP, to serve the new chiller. The new chiller should be connected into the distribution piping at the existing location. New chilled water supply and return headers should be installed to join together the existing distribution systems serving building 1350 and the other seven buildings in the 1300 area. This will create a single chilled water distribution system to be served by the new chiller and the existing 438 ton chiller which was installed in 1983 to serve building 1350. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chillers and pumps, and installation of the new chillers, pumps, associated wiring and controls.

DD FORM 1391

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION P	PROJECT DATA	2. DATE 8/24/95
3. INSTALLATION AND LO FORT SAM HOUS	CATION STON, SAN ANTONIO, TX.		
4. PROJECT TITLE ECIP		5. PROJECT NUMBER	र

This project is required to reduce the cooling energy consumption in the 1300 Area central plant, building 1377. The project provides a new, more efficient primary cooling system, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savinge	3,424	MMBTU/yr
Electrical Demand Savings	13,914	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	3,424	MMBTU/yr
Total Cost Savings	56,936	\$/yr
Total Investment	479,191	\$
Simple Payback	8.4	yrs
SIR	1.98	

CURRENT SITUATION:

There are currently two independent chilled water distribution systems serving the 1300 area, one for building 1350 and the other for seven other buildings. These two systems should be combined into one system to conserve energy in the central plant. This can be accomplished by installing common CHW supply and return headers in the central plant. The existing centrifugal chiller serving building 1350 was installed in 1983, is rated at 438 tons and appears to be in good condition. The two existing centrifugal chillers serving the other seven buildings were installed in 1972, are rated at 600 tons each, and appear to be near the end of their useful life. Also, all three chillers use the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of these machines, they should either be retrofitted to use an approved refrigerant or replaced with new machines that operate on one. The existing centrifugal machines can be retrofitted with no loss of capacity by replacing the impellers with new ones designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the older machines are already over twenty years old, it is recommended that the facility replace them instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a single electric centrifugal chiller using R-134 would be the most economical choice over the life of the machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 1,638 tons is more than what is required to adequately cool the buildings. Therefore, the new combined capacity is recommended to be 1,265 tons to more nearly match the building cooling load.

IMPACT IF NOT PROVIDED

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If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

FORM 1391 PAGE NO. 2 of 2

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY REGION NOS. 6 CENSUS: 3 FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C1 ANALYSIS DATE: 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT 1. INVESTMENT
A. CONSTRUCTION COST \$ 429768.
B. SIOH \$ 23637.
C. DESIGN COST \$ 25786. D. TOTAL COST (1A+1B+1C) \$ 479191. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE G. TOTAL INVESTMENT (1D - 1E - 1F) 479191. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS(5) FUEL A. ELECT \$ 6.28 3424. \$ 21503. 15.08
B. DIST \$.00 0. \$ 0. 18.57
C. RESID \$.00 0. \$ 0. 21.02
D. NAT G \$ 2.66 0. \$ 0. 18.58
E. COAL \$.00 0. \$ 0. 16.83
F. PPG \$.00 0. \$ 0. 17.38
M. DEMAND SAVINGS \$ 13914. 14.88
N. TOTAL 3424. \$ 35417. 324261. 0. 0. 0. 0. \$ 207040. 531301. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 14.88 \$ 33852. 2275. (1) DISCOUNT FACTOR (TABLE A) (2) DISCOUNTED SAVING/COST (3A X 3A1) B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR COST(-) OC DISCNT DISCOUNTED FACTR (3) 1.00 SAVINGS(+)/ COST(-)(4) ITEM (1) (2) 1. REFRIG UPGRADE \$ 384882. 0 384882. d. TOTAL \$ 384882. 384882. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 418734. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 56936. 5. SIMPLE PAYBACK PERIOD (1G/4) 8.42 YEARS \$ 950035. 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.98 (IF < 1 PROJECT DOES NOT QUALIFY) 8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.59 %

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FSH

1. COMPONENT						2.	DATE
ARMY	FY 1997 MILITARY	CONSTRU	CTION	PRO.	IECT DATA		8/24/95
3. INSTALLATION AND LOCATE	ION		4. PRO	JECT TIT	LE		
FORT SAM HO	DUSTON, SAN ANTONIO,	, TX.			E	CIP	
5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJEC	CT NUMB	ER	8. PROJECT	COST (\$000	P)
						557.	0
		9. COST ESTIM	ATES				
	ПЕМ			U/M	QUANTITY	UNIT COST	COST (\$000)
Replace individual bu in Area 100.	uilding chillers with cent	ral chiller p	lant	EΑ	1	557.0	557.0
							3
ESTIMATED CONTR CONTINGENCY (0%) SIOH DESIGN							499.156 0.0 27.454
TOTAL REQUEST							29.949
TOTAL REQUEST (R	(OUNDED)						556.559
,	,						557.000
l e e e e e e e e e e e e e e e e e e e				1	1		

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the 14 existing air cooled, reciprocating chillers serving buildings 122, 124, 125, 128, 133, 134, 135, 142, 143, 144, 146, 147, 149, 197, 198, 199 and 250. Install 6" chilled water supply and return piping loop between the buildings in this area and terminate loop behind building 250, near the existing air cooled chiller installation. Install two new 210 ton, air cooled screw chillers behind building 250. Install two new 30 HP chilled water distribution pumps to circulate water from new chillers through new distribution loop. The existing chilled water pumps that serve buildings where chillers were removed will be reused to circulate chilled water from the new loop through the buildings. These existing pumps should be connected into the new distribution piping at the existing chiller locations. All new controls and electrical services should be installed at building 250 to serve the new chillers and pumps. All54ER specific requirements should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

DD 1 DEC 76 1391

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCT	2. DATE 8/24/95	
3. INSTALLATION AND LO FORT SAM HOUS	CATION STON, SAN ANTONIO, TX.		
4. PROJECT TITLE ECIP		5. PROJECT NUMBE	R

This project is required to reduce the cooling energy consumption in the 100 Area buildings. The project provides new, more efficient primary cooling systems, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	2,816	MMBTU/yr
Electrical Demand Savinge	19,781	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	2,816	MMBTU/yr
Total Cost Savings	64,465	\$/yr
Total Investment	556,559	\$
Simple Payback	8.6	yrs
SIR	1.73	

CURRENT SITUATION:

The 14 existing air cooled, reciprocating chillers in the 100 area were installed in 1985 and serve as the primary cooling systems for 17 buildings. They generally appear to be in fair condition at this time. However, the cost of maintaining so many chillers is excessive and difficult for the maintenance staff. It is recommended that a central chiller plant, consisting of two air cooled screw machines be installed to serve all these buildings. This will not only save energy but will also greatly reduce the maintenance costs to the installation. Computer simulations of the buildings in this area determined that the current installed capacity of 540 tons is more than is required to adequately cool the buildings. Therefore, it is recommended that the two new chillers be rated at a combined 420 tons to more closely match the cooling load of the buildings.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID ILLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-I ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST \$ 499156. B. SIOH B. SIOH
C. DESIGN COST 27454. 29949. D. TOTAL COST (1A+1B+1C) \$ 556559. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE \$ 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 556559. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL MBTU/YR(2) SAVINGS(3) FACTOR(4) \$/MBTU(1) SAVINGS(5) 2816. 0. 0. 0. A. ELECT \$ 6.28 17684. 15.08 266682. .00 B. DIST \$ 0. 18.57 0. C. RESID \$.00 0. 0. 0. 0. 21.02 0. D. NAT G \$ 2.66 18.58 \$ 16.83 \$ 0. .00 \$ E. COAL \$ 0. F. PPG \$.00 0. 17.38 \$ \$ 19781. M. DEMAND SAVINGS 14.88 294341. 2816. \$ N. TOTAL 37465. 561023. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 27000. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) \$ 401760. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED
COST(-) OC FACTR SAVINGS(+)/
(1) (2) (3) COST(-)(4) DISCOUNTED ITEM SAVINGS(+)/ d. TOTAL 0. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 401760. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 64465. 5. SIMPLE PAYBACK PERIOD (1G/4) 8.63 YEAF 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 962783. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =1.73 (IF < 1 PROJECT DOES NOT QUALIFY)

1. COMPONENT						2. [PATE
ARMY	FY 1997 MILITARY	CONSTRU	CTION	PROL	IECT DATA		8/24/95
3. INSTALLATION AND LOCATIO			4. PRO	JECT TIT	LE		
FORT SAM HOL	USTON, SAN ANTONIO	, TX.					
5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJEC	T MILLIE	ED	a ppo IECT	COST (\$000)	
5. PROGRAM ELEMENT	O. CATAGORT CODE	7. PROJEC	JI NUMDI	EK	o. rkweci	237.0	
						201.0	
		9. COST ESTIM	ATES				
	ITEM			и/м	QUANTITY	UNIT COST	COST (\$000)
	IIEM			U/M	COANTITI	UNIT COST	(\$000)
Replace existing chille	er with new centrifugal	chiller in		EA	1	237.0	237.0
building 2265.	or with how comprising				•	207.0	20710
bullating 2200.							
ESTIMATED CONTRA	ACT COST						
CONTINGENCY (0%)						ļ	212.626
SIOH						1	0.0
DESIGN							11.694
DESIGN				•			12.758
TOTAL PROUPOT							12.750
TOTAL REQUEST							
	1						237.078
TOTAL REQUEST (RO	DUNDED)						
							237.000
							1

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the existing 675 ton, R-11 centrifugal chiller in building 2265 and replace it with a 555 ton, R-134a centrifugal chiller. The existing 100 HP chilled water (CHW) pump, 50 HP condenser water (CND) pump and 40 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

DD 1 DEC 76 1391

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJEC	CT DATA	2. DATE 8/24/95
3. INSTALLATION AND LO FORT SAM HOUS	CATION STON, SAN ANTONIO, TX.		
4. PROJECT TITLE		5. PROJECT NUMBER	

This project is required to reduce the cooling energy consumption in the 2200 Area central plant. The project provides new, more efficient primary cooling systems, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	1,304	MMBTU/yr
Electrical Demand Savings	11,822	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	1,304	MMBTU/yr
Total Cost Savings	37,433	\$/yr
Total Investment	237,078	\$
Simple Payback	6.3	yrs
SIR	2.73	

CURRENT SITUATION:

The existing water cooled, centrifugal chiller was installed in 1973 and serves as the primary cooling system for the four large buildings in the 2200 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the machine is already 22 years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that an electric centrifugal chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 657 tons is more than what is required to adequately cool the buildings. Therefore, the new chiller should only be sized for 555 tons to more closely match the cooling load of the four buildings.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

DD 1 DEC 76 1391

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
ALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 INSTALLATION & LOCATION: FSH
PROJECT NO. & TITLE: 03018504 EF EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E1 ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST \$ 212626. B. SIOH 11694. C. DESIGN COST 12758. D. TOTAL COST (1A+1B+1C) \$ 237078. 0. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 237078. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS(5) FUEL 6.28 1304. \$ 8189. .00 0. \$ 0. .00 0. \$ 0. 2.66 0. \$ 0. .00 0. \$ 0. .00 0. \$ 0. SAVINGS \$ 11822. 1304. \$ 20011. A. ELECT \$ 15.08 123492. B. DIST \$.00 18.57 0. C. RESID S 21.02 0. D. NAT G \$ 2.66 18.58 0. E. COAL \$ 10.02 17.38 16.83 0. F. PPG \$ 0. 14.88 M. DEMAND SAVINGS \$ 175911. N. TOTAL \$ 299403. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT COST(-) OC FACTR DISCOUNTED SAVINGS(+)/ ITEM (1) (2) (3) COST(-)(4)1. REFRIG UPGRADE \$ 348435. 0 1.00 348435. d. TOTAL \$ 348435. 348435. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 348435. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 37433. 5. SIMPLE PAYBACK PERIOD (1G/4) 6.33 YEAR 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 647838. 7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.73 (IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FSH

1. COMPONENT						2. 1	DATE
ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA 8/24/95					8/24/95	
3. INSTALLATION AND LOCATION			4. PRO	UECT TIT	LE		
FORT SAM HOU	STON, SAN ANTONIO,	TX.	5				
5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJEC	CT NUMB	ER	8. PROJECT	COST (\$000)	
						157.0)
		9. COST ESTIM	ATES				
	ІТЕМ			U/M	QUANTITY	UNIT COST	COST (\$000)
Replace existing chiller with new screw chiller in building		3	EA	1	157.0	157.0	
902.							
					ii		
ESTIMATED CONTRAC	CT COST						
CONTINGENCY (0%)							141.037
SIOH							0.0
DESIGN							7.757
							8.462
TOTAL REQUEST							157.056
TOTAL REQUEST (RO	INDED)						157.256
I TOTAL REGULOT (NO	ONULUJ						157.000
						1	

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the existing 300 ton, R-11 centrifugal chiller in building 902 and replace it with a 300 ton, R-134a screw chiller. The existing 25 HP chilled water (CHW) pump, 15 HP condenser water (CND) pump and 15 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

DD 1 DEC 76 1391

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95			
3. INSTALLATION AND LOCATION FORT SAM HOUSTON, SAN ANTONIO, TX.					
4. PROJECT TITLE	5. PROJECT NU	MBER			

This project is required to reduce the cooling energy consumption in the 900 Area central plant. The project provides new, more efficient primary cooling systems, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	434	MMBTU/yr
Electrical Demand Savings	2,520	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	434	MMBTU/yr
Total Cost Savings	17,650	\$/yr
Total Investment	157,256	\$
Simple Payback	8.9	yrs
SIR	2.08	

CURRENT SITUATION:

The existing water cooled, centrifugal chiller was installed in 1985 and serves as the primary cooling system for the 21 buildings in the 900 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the machine is already ten years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a dual screw chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 300 tons is required to adequately cool the buildings. Therefore, no increase or decrease in the current chiller capacity is recommended at this time.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

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LIFE CYCLE COST ANALYSIS SUMMARY
                                                        STUDY: FSH
       ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
                                                       LCCID FY95 (92)
  INSTALLATION & LOCATION: FSH
                                        REGION NOS. 6 CENSUS: 3
  PROJECT NO. & TITLE: 03018504
                                    EEAP BOILER CHILLER STUDY
                   DISCRETE PORTION NAME: ECO-A3
  FISCAL YEAR 96
  ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER
  1. INVESTMENT
  A. CONSTRUCTION COST
                               141037.
  B. SIOH
                                 7757.
  C. DESIGN COST
                                 8462.
  D. TOTAL COST (1A+1B+1C) $
                               157256.
  E. SALVAGE VALUE OF EXISTING EQUIPMENT $
  F. PUBLIC UTILITY COMPANY REBATE
                                                0.
  G. TOTAL INVESTMENT (1D - 1E - 1F)
                                                         157256.
  2. ENERGY SAVINGS (+) / COST (-)
  DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994
               UNIT COST SAVINGS
                                                    DISCOUNT
                                       ANNUAL $
                                                               DISCOUNTED
      FUEL
               $/MBTU(1)
                          MBTU/YR(2)
                                       SAVINGS(3)
                                                    FACTOR(4)
                                                               SAVINGS (5)
      A. ELECT $
                  6.28
                             434.
                                            2726.
                                                       15.08
                                                                    41101.
      B. DIST $
                  .00
                                              0.
                               0.
                                                       18.57
                                                                      0.
                  .00
      C. RESID $
                              0.
                                              0.
                                                       21.02
                                                                       0.
      D. NAT G S
                  2.66
                              0.
                                              0.
                                                       18.58
                                                                       0.
                              0.
      E. COAL
                  .00
               Ŝ
                                              Ο.
                                                       16.83
                                                                       0.
      F. PPG $
                  .00
                              0.
                                              0.
                                                       17.38
                                                                       0.
      M. DEMAND SAVINGS
                                       $ 2520.
                                                       14.88
                                                                    37498.
      N. TOTAL
                             434.
                                           5246.
                                                                    78598.
  3. NON ENERGY SAVINGS(+) / COST(-)
     A. ANNUAL RECURRING (+/-)
                                                                       0.
         (1) DISCOUNT FACTOR (TABLE A)
                                                       14.88
         (2) DISCOUNTED SAVING/COST (3A X 3A1)
                                                                       0.
     B. NON RECURRING SAVINGS(+) / COSTS(-)
                              SAVINGS(+)
                                          YR
                                               DISCNT
                                                          DISCOUNTED
                               COST(-)
                                         OC
                                               FACTR
                                                          SAVINGS(+)/
                                   (1)
                                         (2)
                                                (3)
                                                          COST(-)(4)
      1. REFRIG UPGRADE
                              $ 248085.
                                         0
                                                1.00
                                                            248085.
      d. TOTAL
                              $ 248085.
                                                           248085.
     C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 248085.
  4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 17650.
  5. SIMPLE PAYBACK PERIOD (1G/4)
                                                                  8.91 YEARS
  6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)
                                                                 326683.
  7. SAVINGS TO INVESTMENT RATIO
                                        (SIR) = (6 / 1G) =
                                                                  2.08
      (IF < 1 PROJECT DOES NOT QUALIFY)
*** Project does not qualify for ECIP funding; 4,5,6 for information only.
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p.

1. COMPONENT						2. 0	PATE
ARMY	FY 1997 MILITA	RY CONSTRU	CTION	PROJ	ECT DATA		8/24/95
3. INSTALLATION AND LO	CATION		4. PRO	JECT TIT	LE		
FORT SAM	HOUSTON, SAN ANTON	NO, TX.					
5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJEC	CT NUMBI	ER	8. PROJECT	соэт (\$000) 479.(
		9. COST ESTIM	ATES				
	ITEM			U/M	QUANTITY	UNIT COST	COST (\$000)
Replace two (2) e (1) new chiller.	xisting chillers in buildir	1g 1377 with o	ne ,	EA	1	479.0	479.0
ESTIMATED CON' CONTINGENCY (C SIOH DESIGN							429.768 0.0 23.673 25.786
TOTAL REQUEST							479.191
TOTAL REQUEST	(ROUNDED)						479.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the two 600 ton, R-11 centrifugal chillers in building 1377 which were installed in 1972, and replace them with one R-134 centrifugal chiller, rated at 827 tons. The two existing chilled water pumps and condenser water pumps serving the existing chillers should be removed. Install a new chilled water pump and a new condenser water pump, each rated at 75 HP, to serve the new chiller. The new chiller should be connected into the distribution piping at the existing location. New chilled water supply and return headers should be installed to join together the existing distribution systems serving building 1350 and the other seven buildings in the 1300 area. This will create a single chilled water distribution system to be served by the new chiller and the existing 438 ton chiller which was installed in 1983 to serve building 1350. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chillers and pumps, and installation of the new chillers, pumps, associated wiring and controls.

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95					
	ORT SAM HOUSTON, SAN ANTONIO, TX.						
4. PROJECT TITLE	5. PROJECT NUMBER	3					

11. REQUIREMENT

This project is required to reduce the cooling energy consumption in the 1300 Area central plant, building 1377. The project provides a new, more efficient primary cooling system, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	3,424	MMBTU/yr
Electrical Demand Savings	13,914	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	3,424	MMBTU/yr
Total Cost Savings	56,936	\$/yr
Total Investment	479,191	\$
Simple Payback	8.4	yrs
SIR	1.98	

CURRENT SITUATION:

There are currently two independent chilled water distribution systems serving the 1300 area, one for building 1350 and the other for seven other buildings. These two systems should be combined into one system to conserve energy in the central plant. This can be accomplished by installing common CHW supply and return headers in the central plant. The existing centrifugal chiller serving building 1350 was installed in 1983, is rated at 438 tons and appears to be in good condition. The two existing centrifugal chillers serving the other seven buildings were installed in 1972, are rated at 600 tons each, and appear to be near the end of their useful life. Also, all three chillers use the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of these machines, they should either be retrofitted to use an approved refrigerant or replaced with new machines that operate on one. The existing centrifugal machines can be retrofitted with no loss of capacity by replacing the impellers with new ones designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the older machines are already over twenty years old, it is recommended that the facility replace them instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a single electric centrifugal chiller using R-134 would be the most economical choice over the life of the machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 1,638 tons is more than what is required to adequately cool the buildings. Therefore, the new combined capacity is recommended to be 1,265 tons to more nearly match the building cooling load.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

DD 1 DEC 76 1391

PAGE NO. 2 of 2

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LCCID FY95 (92)

LLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C1 ANALYSIS DATE: 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST \$ 429768. B. SIOH \$ 23637. C. DESIGN COST \$ 25786. D. TOTAL COST (1A+1B+1C) \$ 479191. 23637. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 479191. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) FUEL SAVINGS(5)

 3424.
 \$ 21503.

 0.
 \$ 0.

 0.
 \$ 0.

 0.
 \$ 0.

 0.
 \$ 0.

 0.
 \$ 0.

 \$ 13914.

 3424.
 \$ 35417.

 A. ELECT \$ 6.28 3424. 15.08 324261. B. DIST \$.00 0. C. RESID \$.00 0. D. NAT G \$ 2.66 0. 18.57 0. 21.02 0. 18.58 16.83 0. E. COAL \$.00 0. \$.00 F. PPG 17.38 14.88 M. DEMAND SAVINGS 207040. N. TOTAL 531301. 3. NON ENERGY SAVINGS(+) / COST(-) \$ 2275. A. ANNUAL RECURRING (+/-) (1) DISCOUNT FACTOR (TABLE A) 14.88 \$ 33852. (2) DISCOUNTED SAVING/COST (3A X 3A1) B. NON RECURRING SAVINGS(+) / COSTS(-) DISCOUNTED SAVINGS (+) / SAVINGS(+) YR DISCNT COST(-) OC FACTR ITEM COST(-) OC (1) (2)

1. REFRIG UPGRADE \$ 384882. 0 (2) (3) COST(-)(4)1.00 384882. d. TOTAL \$ 384882. 384882. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 418734. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 56936. 8.42 YEARS 5. SIMPLE PAYBACK PERIOD (1G/4) \$ 950035. 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.98 (IF < 1 PROJECT DOES NOT QUALIFY) 6.59 % 8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):

1. COMPONENT						2. [DATE
							8/24/95
3. INSTALLATION AND LOCAT	ION		4. PRO	DJECT TI	TLE		
FORT SAM HO	DUSTON, SAN ANTONIO,	TX.					
5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJEC	CT NUMB	ER	8. PROJECT		
						164.0)
9. COST ESTIMATES							
ITEM U/M QUANTITY UNIT COS						UNIT COST	COST (\$000)
Replace existing boil	lers with new high efficier	ncy modula	ar	EA	1	164.0	164.0
boilers in building 13							
1							
ESTIMATED CONTR	ACT COST						
CONTINGENCY (0%							146.838
SIOH)						0.0
DESIGN					1		8.076
							8.810
TOTAL REQUEST							
							163.724
TOTAL REQUEST (R	OUNDED)						
							164.000
I				1	1		3

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the two existing watertube boilers and single 40 HP heating water (HW) distribution pump in building 1377, which are serving building 1350. Also remove the two existing firetube boilers and the two 15 HP distribution pumps in building 1377 which serve buildings 1374, 1375, 1379, 1380, 1382, 1377 and 1385. Connect the two separate distribution loops together in building 1377 with new HW supply and return headers to make a single HW distribution system. Install four new modular high efficiency boilers, rated at 1,830 MBH output each and four new 7 ½ HP distribution pumps to serve this single system. The existing electrical service and controls should be reused as much as possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. The boilers and pumps should be sequenced to operate only as needed to maintain the supply water temperature setpoint of approximately 180 F. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and pumps, and installation of the new boilers, pumps, associated wiring and controls.

DD 1 DEC 76 1391

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJEC	CT DATA	2. DATE 8/24/95
3. INSTALLATION AND LO FORT SAM HOUS	CATION STON, SAN ANTONIO, TX.		
4. PROJECT TITLE		5. PROJECT NUMBER	3

11. REQUIREMENT

This project is required to reduce the heating energy consumption in the 1300 Area central plant. The project provides new, more efficient primary heating systems, which will save heating energy and cost. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	712	MMBTU/yr
Electrical Demand Savings	1,847	\$/yr
Gas Energy Savings	4,020	MMBTU/yr
Total Energy Savings	4,732	MMBTU/yr
Total Cost Savings	17,012	\$/yr
Total investment	163,724	\$
Simple Payback	9.6	yrs
SIR	1.79	

CURRENT SITUATION:

The two existing watertube boilers serving building 1350 were installed in 1983 and are rated at 5,317 MBH and 4,336 MBH output capacity. The single 40 HP pump circulates HW from these boilers through building 1350. The two existing firetube boilers serving the other buildings in the 1300 area were installed in 1972 and are rated at 5,912 MBH output capacity each. Two 15 HP pumps circulate HW from these boilers to the seven other buildings listed above. All these boilers appear to be in fair condition. Computer simulations of the eight buildings served by these boilers determined that the current combined capacity of 21,477 MBH is about three times the amount required to adequately heat the buildings. The existing boilers are therefore operating at an inefficient, low load condition most of the time. Also, because of the constant flow rate requirements of the large boilers, excessive pumping energy is expended. By combining the two distribution systems together and staging four new high efficiency modular boilers to operate only as needed, a substantial energy savings can be realized. Also, a decrease in the combined boiler output capacity to 7,320 MBH is recommended to more closely match the heating load in the eight buildings and reduce the associated pumping energy consumption.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in heating energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

STUDY: FSH LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-D ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 146838. B. SIOH 8076. C. DESIGN COST 8810. D. TOTAL COST (1A+1B+1C) \$ 163724. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 163724. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS(5) A. ELECT \$ 6.28 712. 4471. 15.08 67428. 0. \$ 0. 0. \$ 0. 0. \$ 10693. 0. \$ 0. 0. \$ 0. B. DIST \$.00 18.57 0. .00 4020. C. RESID \$ 21.02 0. D. NAT G \$ 2.66 18.58 198680. .00 E. COAL \$ 16.83 0. .00 F. PPG \$ 17.38 0. \$ 1847. 4732. \$ 17012. M. DEMAND SAVINGS 14.88 27483. N. TOTAL 293591. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED ITEM COST(-) OC FACTR SAVINGS(+)/ (1) (2) (3) COST(-)(4)d. TOTAL 0. 0. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 0. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 17012. 5. SIMPLE PAYBACK PERIOD (1G/4) 9.62 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 293591. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =1.79 (IF < 1 PROJECT DOES NOT QUALIFY)

	(O)						
1. COMPONENT		-0				2. 0	
ARMY	FY 1997 MILITARY	CONSTRU	CTION	PRO.	JECT DATA		8/24/95
3. INSTALLATION AND LOCATION			4. PRO	DJECT TIT	LE		
FORT SAM HOUS	STON, SAN ANTONIO,	TX.					
5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJEC	T NUMB	ER	8. PROJECT	•	
						557.0)
	;	9. COST ESTIM	ATES				
ITEM U/M QUANTITY UNIT COST							COST (\$000)
Replace individual build	ling chillers with cent	ral chiller p	lant	EA	1	557.0	557.0
in Area 100.							
	T 000T						
ESTIMATED CONTRAC	1 (051						499.156
CONTINGENCY (0%)							0.0
DESIGN							27.454
							29.949
TOTAL REQUEST							
							556.559
TOTAL REQUEST (ROL	JNDED)						557,000
							557.000
							1

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the 14 existing air cooled, reciprocating chillers serving buildings 122, 124, 125, 128, 133, 134, 135, 142, 143, 144, 146, 147, 149, 197, 198, 199 and 250. Install 6" chilled water supply and return piping loop between the buildings in this area and terminate loop behind building 250, near the existing air cooled chiller installation. Install two new 210 ton, air cooled screw chillers behind building 250. Install two new 30 HP chilled water distribution pumps to circulate water from new chillers through new distribution loop. The existing chilled water pumps that serve buildings where chillers were removed will be reused to circulate chilled water from the new loop through the buildings. These existing pumps should be connected into the new distribution piping at the existing chiller locations. All new controls and electrical services should be installed at building 250 to serve the new chillers and pumps. All54ER specific requirements should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

DD 1 DEC 76 1391

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95
3. INSTALLATION AND LO FORT SAM HOUS	CATION STON, SAN ANTONIO, TX.	
4. PROJECT TITLE	5. PROJEC	CT NUMBER

11. REQUIREMENT

This project is required to reduce the cooling energy consumption in the 100 Area buildings. The project provides new, more efficient primary cooling systems, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	2,816	MMBTU/yr
Electrical Demand Savings	19,781	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	2,816	MMBTU/yr
Total Cost Savings	64,465	\$/yr
Total Investment	556,559	\$
Simple Payback	8.6	yrs
SIR	1.73	

CURRENT SITUATION:

The 14 existing air cooled, reciprocating chillers in the 100 area were installed in 1985 and serve as the primary cooling systems for 17 buildings. They generally appear to be in fair condition at this time. However, the cost of maintaining so many chillers is excessive and difficult for the maintenance staff. It is recommended that a central chiller plant, consisting of two air cooled screw machines be installed to serve all these buildings. This will not only save energy but will also greatly reduce the maintenance costs to the installation. Computer simulations of the buildings in this area determined that the current installed capacity of 540 tons is more than is required to adequately cool the buildings. Therefore, it is recommended that the two new chillers be rated at a combined 420 tons to more closely match the cooling load of the buildings.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-I ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 499156. B. SIOH \$ 27454. C. DESIGN COST 29949. D. TOTAL COST (1A+1B+1C) \$ 556559. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 556559. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS (5) A. ELECT \$ 6.28 17684. 266682. 2816. 15.08 .00 B. DIST \$ 0. \$ 0. 18.57 0. \$ C. RESID \$.00 0. 0. 21.02 0. D. NAT G \$ 2.66 0. 0. 18.58 0. \$ E. COAL \$.00 Ο. 16.83 0. 0. F. PPG \$ \$.00 0. 17.38 0. 0. 2816. \$ M. DEMAND SAVINGS 19781. 14.88 294341. N. TOTAL 37465. 561023. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) \$ 27000. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 401760. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED ITEM COST(-) OC FACTR SAVINGS(+)/ (1)(2) (3) COST(-)(4)d. TOTAL 0. 0. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 401760. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 64465. 5. SIMPLE PAYBACK PERIOD (1G/4) 8.63 YEAF 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 962783. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 1.73

(IF < 1 PROJECT DOES NOT QUALIFY)

APPENDIX A
ENERGY COST ANALYSIS

APPENDIX A ENERGY COST ANALYSIS

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	Gas Rate Schedules	
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APPENDIX A ENERGY COST ANALYSIS

A. Electrical Energy Cost Analysis

Electrical Rate Schedule: The post purchases it's electrical power from the City Public Service (CPS) of San Antonio, and is billed under the Super Large Power (SLP) rate. Service is provided through a single substation on the post, owned by the Army. The SLP rate has been in effect since January of 1994, and was created by the utility company to lower military base charges, thereby helping to avoid base closures. This rate has resulted in substantial cost decreases, even though the electrical usage on the post has increased. The monthly SLP billing rate components are as follows:

Service Availability Charge: \$1,000

Energy Charge: \$0.024/KWH

Demand Charge: \$10.00/KW billing demand (June through September)

\$7.50/KW billing demand (October through May)

where: billing demand is the highest 15 minute metered KW

demand during the month, or 5000 KW, or 80% of highest billing demand from previous June through September (applicable only from October through May),

whichever is greatest

Fuel Cost Adjustment: calculated monthly, difference between actual fuel cost

and \$0.016/KWH (average variance from base year data

is -\$0.002566/KWH)

Avoided Costs: In order to convert electric demand and energy savings into dollar savings, the avoided costs of demand and energy are determined. These are the marginal cost savings to be realized by the post, per unit of demand or energy saved. Using the above billing components, the Avoided Cost of Demand ($C_{SD} \& C_{WD}$) and the Avoided Cost of Energy (C_{E}) are determined as follows:

$$C_{SD} = \frac{\$10.00}{KW}$$
 (June through September)

$$C_{WD} = \frac{\$7.50}{KW}$$
 (October through May)

$$C_E = (E + F) x \frac{KWH}{3413 BTU} x \frac{1,000,000 BTU}{MMBTU} \frac{\$}{MMBTU}$$

$$C_E = (0.024 - 0.002566) \times \frac{1,000,000}{3413} = \frac{\$6.28}{MMBTU}$$

Rebate Program: The City Public Service of San Antonio currently offers no cash incentives for energy conservation retrofits.

B. Natural Gas Energy Cost Analysis

Gas Rate Schedules: FSH is currently supplied natural gas by CPS through many meters distributed throughout the post. However, the meters serving areas 900, 1300, 2200 and the quadrangle are all billed under the Large Volume Gas (LVG) rate. The monthly LVG billing rate components are as follows:

Service Availability Charge:

\$325

Energy Charge:

\$2.65/MCF

Fuel Adjustment:

calculated monthly, difference between actual gas cost and

\$2,20/MCF (average variance from base year data is

\$0.0142/MCF)

Demand Charge:

\$0.080/(MCF/day)

(December through March)

\$0.064/(MCF/day)

(April through November)

where:

billing demand is the monthly gas consumption (MCF) divided by the number of days in the month, or 60 MCF/day, or the maximum billing demand established during the period of December through March (applicable only during

April through November), whichever is greatest

The buildings in the area 100 have individual gas meters and are billed under the Residential Gas (RG) rate #4. The monthly RG billing rate components are as follows:

Service Availability Charge:

\$3.85

Energy Charge:

\$4.38/MCF

Fuel Adjustment:

calculated monthly, difference between actual gas cost and

\$2.20/MCF (average variance from base year data is

\$0.0142/MCF)

Avoided Costs: In order to convert gas energy savings or penalties into cost savings or penalties, the Avoided Cost of Gas (C_G) is determined for each rate schedule described above as follows:

Areas 900, 1300, 2200 and Quadrangle,

$$C_G = (E + F) \times \frac{1 MCF}{MMBTU}$$
 $\frac{\$}{MMBTU}$

where,

E = energy charge = \$2.65 per MCF

F = fuel adjustment = \$0.0142 per MCF (average from base year data)

$$C_G$$
 = (2.65 + 0.0142) = 2.66 $\frac{\$}{MMBTU}$

Area 100,

$$C_G = (E + F) \times \frac{1 MCF}{MMBTU}$$
 $\frac{\$}{MMBTU}$

where,

E = energy charge = \$4.38 per MCF

F = fuel adjustment = \$0.0142 per MCF (average from base year data)

$$C_G$$
 = (4.38 + 0.0142) = 4.39 $\frac{\$}{MMBTU}$

APPENDIX B COMPUTER MODELING OF BOILER & CHILLER SYSTEMS

APPENDIX B COMPUTER MODELING OF BOILER & CHILLER SYSTEMS

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APPENDIX B COMPUTER MODELING OF BOILER & CHILLER SYSTEMS

- A. General Parameters. The following assumptions and estimates were used in the modeling of the existing buildings which are served by the boilers and chillers included in this study.
 - 1. The Trace 600 weather data for San Antonio, Texas was used in all of the computer simulations.
 - 2. The Trace 600 computer simulations were performed for the months of January through December to determine annual HVAC equipment energy consumptions.
 - 3. A special holiday schedule was created to incorporate the additional holidays that military personnel living in the area 900 and 1300 barracks buildings receive. This schedule includes the seven standard holidays plus the period from December 17 through 31. The standard seven day holiday schedule was used for all other areas.
 - 4. All building dimensions and construction data were determined from as-built drawings when available, or from field measurements taken during the site visit.
 - 5. Design room temperatures (thermostat setpoints) were obtained from CEMP-E (9 December 1991) Chapter 13, Section 3. These temperatures were 78°F for cooling and 70°F for heating. No cooling or heating temperature setback control was included in the simulations.
 - 6. The shading coefficient for all windows with interior blinds was estimated at 0.67 per ASHRAE data.
 - 7. The number of people in each building or room was estimated from interviews with post personnel. The sensible and latent heat gain rates used for the people in each room were taken from ASHRAE data.
 - 8. Building and room lighting loads were obtained from as-built drawings when available, or from field notes taken during the site visit.
 - 9. Building and room miscellaneous equipment loads were estimated from field notes taken during the site visit. These loads represent the internal heat gains generated from equipment in the rooms, such as computers, televisions, cooking equipment, etc. Heat gain data for the various types of internal loads was taken from ASHRAE.
 - 10. For all building areas with forced ventilation, the rates were taken from ASHRAE Standard 62-1989 or from schedule data on the existing air handlers, whichever was greater.
 - 11. For all barracks buildings with operable windows and no forced ventilation, infiltration rates were assumed to be equal to building or room exhaust rates.
 - 12. Building and room exhaust rates were taken from as-built drawings.

- B. People, Lights and Miscellaneous Equipment Schedules. The following assumptions and estimates were used in the modeling of the existing buildings which are served by the boilers and chillers included in this study.
 - 1. Offices and Classrooms: During the weekdays, all people, lights and miscellaneous equipment were scheduled at 100% from 8 am until 12 pm, and from 1 pm until 5 pm. During the lunch hour, from 12 pm until 1 pm, all internal loads were scheduled at 10%. On the weekends and holidays, all loads were scheduled at 0%.

Barracks:

- a. People During the weekdays, all people were scheduled at 5% between 8 am and 5 pm. Between 5 pm and 10 pm, they were scheduled at 80%, and between 10 pm and 8 am, they were scheduled at 100%. During the weekends and holidays, the people were scheduled at 50% all day long.
- b. Lights and Miscellaneous Equipment During the weekdays, the lights and miscellaneous equipment (TVs, radios, etc.) were scheduled at 5% between 8 am and 5 pm. Between 5 pm and 10 pm, they were scheduled at 80%, and between 10 pm and 8 am, they were scheduled at 5%. During the weekends and holidays, the lights and miscellaneous equipment were scheduled at 50% from 8 am until 10 pm, and 5% from 10 pm until 8 am.

3. Dining Areas:

- a. People During the weekdays, weekends and holidays, all people were scheduled at 100% between 6 am and 9 am, between 11 am and 2 pm, and between 5 pm and 7 pm. They were scheduled at 0% at all other times.
- b. Lights and Miscellaneous Equipment During the weekdays, weekends and holidays, all lights and miscellaneous equipment were scheduled at 100% between 5 am and 7 pm. They were scheduled at 0% at all other times.
- 4. Kitchen Areas: During the weekdays, weekends and holidays, all people, lights and miscellaneous equipment were scheduled at 100% from 4 am until 9 pm. They were scheduled at 0% at all other times.
- C. HVAC Equipment Schedules. The following assumptions and estimates were used in the modeling of the existing buildings which are served by the boilers and chillers included in this study.
 - 1. All fan coil and air handler fans were scheduled to operate 100% of the day, 12 months of the year, as required by room thermostats to maintain building setpoint temperatures.
 - 2. All fan coil and air handler cooling coils were scheduled to operate 100% of the day, from May through October, as required by room thermostats to maintain building setpoint temperatures.
 - 3. All fan coil and air handler heating coils were scheduled to operate 100% of the day, from November through April, as required by room thermostats to maintain building setpoint temperatures.
 - 4. All building infiltration and ventilation air is scheduled to be introduced into the buildings at a fixed rate 100% of the day, 12 months per year.

- 5. All building and room thermostats were scheduled to maintain the design setpoints 24 hours per day, 12 months per year with no setback periods.
- D. Building HVAC Systems. The following assumptions and estimates were used in the modeling of the existing buildings which are served by the boilers and chillers included in this study.
 - 1. HVAC air system types were taken from building as-built drawings when available, or from field notes taken during the site visit.
 - 2. In order to simplify the calculations, most buildings were modeled as a single 'zone' served by a single HVAC air system. Other buildings with more diverse occupancies were zoned as shown on as-built drawings and served by individual HVAC air systems in order to generate a more realistic load profile for the boilers and chillers.
 - Each building HVAC air system was assumed to have a chilled water coil for cooling and a
 heating water coil for heating. These coils were assumed to be served by two-pipe distribution
 systems within the buildings.
- E. Boiler & Chiller Systems. The following assumptions and estimates were used in the modeling of the boiler and chiller systems included in this study.
 - Existing boiler and chiller systems types were identified during the field inspection and used in the computer simulations. They're full load capacity and energy consumption rates were input to match the existing systems. The Trace 600 models were used for part load performance of the existing boilers and chillers.
 - 2. It was assumed that all existing chillers had a full load KW/ton increase of 1% over their original rating for each year of service up to ten years. For all service over ten years, 0.25% per year was added to the full load KW/ton rating. This was done to account for natural efficiency losses due to tube fouling and compressor wear.
 - 3. It was assumed that all existing boilers had a full load efficiency decrease of 1% under their original rating for each year of service up to ten years. For all service over ten years, 0.25% per year was deducted from the full load efficiency rating. This was done to account for natural efficiency losses due to tube fouling and burner wear.
 - 4. The existing pumping horsepower for all associated pumps was also input to simulate the existing systems.
 - 5. In area 900, a base load of 565 MBH per hour was imposed on the existing and proposed boilers to account for the generation of domestic hot water in the barracks buildings. This base load increases the required boiler capacity and shows up as 'base utility' in the equipment energy consumption output sheets.
 - 6. Proposed boiler and chiller alternatives were selected for comparison in the computer simulations. Full load capacity and energy consumption rates were obtained from manufacturer's data and input into the computer simulations. When available, part load energy consumption data from the manufactures was used in the simulations.
 - 7. All new chillers were selected from the top 25% of their class in terms of efficiency (KW/ton), and also were at least 10% more efficient than current design standards.

- 8. New pumping horsepower for all associated pumps was estimated for all proposed boilers and chillers and input to simulate the new systems.
- 9. Existing cooling tower systems were identified during the field inspection and used in the computer simulations. They're existing fan horsepower was also input to simulate the existing towers.
- 10. In all areas, a base load was added to the chillers and boilers to account for heat loss or gain from circulating pumps and piping insulation. These base loads increased the required capacity of the boilers and chillers and show up as 'base utility' in the equipment energy consumption output sheets.

01 Card - Job Information

Project: 030185.04 EEAP BOILER-CHILLER STUDY Location: FT. SAM HOUSTON - SAN ANTONIO, TX. Client: CORPS. OF ENGINEERS - FORT WORTH, TX.

Program User: HUITT-ZOLLARS INC.

Comments: AREA 900

----- Load Section Alternative #1 -----

Card 19- Load Alternative Number Description
1 EXISTING BUILDINGS

Card 20------ General Room Parameters ------Zone Acoustic Floor to Duplicate Duplicate Perimeter Room Reference Room Floor Floor Const Plenum Ceiling Floor Floors Rooms per Depth Number Number Descrip Length Width Type Height Resistance Height Multiplier Zone 5 5 BLDG 904 103 103 3 0 2.54 9.5 BLDG 907 10 10 103 103 3 0 2.54 9.5 15 15 BLDG 920 103 103 3 0 2.54 9.5 20 20 BLDG 926 103 103 3 9.5 3 103 103 25 25 BLDG 915 n 2.54 9.5 30 30 BLDG 921 103 103 0 2.54 9.5 2.54 103 103 3 0 35 35 BLDG 929 9.5 40 40 BLDG 932 103 103 3 0 2.54 9.5 45 45 BLDG 905 103 103 3 0 2.54 9.5

	Zone						Acoustic	Floor to	Duplicate	Duplicate	Perimeter
Room	Reference	Room	Floor	Floor	Const	Plenum	Ceiling	Floor	Floors	Rooms per	Depth
Number	Number	Descrip	Length	Width	Type	Height	Resistance	Height	Multiplier	Zone	
50	50	BLDG 906	103	103	3	C	2.54	9.5			
55	55	BLDG 924	103	103	3	0	2.54	9.5			
50	60	BLDG 925	103	103	3	0	2.54	9.5			
55	65	BLDG 916	103	103	3	0	2.54	9.5			
70	70	BLDG 917	103	103	3	0	2.54	9.5			
75	75	BLDG 930	103	103	3	0	2.54	9.5			
30	80	BLDG 931	103	103	3	0	2.54	9.5			
35	85	BLDG 908	46	46	3	1.5	2.54	10			
90	90	BLDG 919 .	46	46	3	1.5	2.54	10			
75	95	BLDG 922	46	46	3	1.5	2.54	10			
00	100	BLDG 928	46	46	3	1.5	2.54	10			
105	105	BLDG 902	136	137	3	4	2.54	13			

Card 21			• • • • • • • • • • • • • • • • • • • •	Therm	ostat Param	eters				
	Cooling	Room	Cooling	Cooling	Heating	Heating	Heating	T'stat	Mass /	Carpet
Room	Room	Design	T'stat	T'stat	Room	T'stat	T'stat	Location	No. Hrs	On
Number	Design DB	RH	Driftpoint	Schedule	Design DB	Driftpoint	Schedule	Flag	Average	Floor
5	78	50	78		70	70		ROOM	LIGHT30	NO
10	78	50	78		70	70		ROOM	LIGHT30	NO
15	78	50	78		70	70		ROOM	LIGHT30	NO
20	78	50	78		70	70		ROOM	LIGHT30	NO
25	78	50	78		70	70		ROOM	LIGHT30	NO
30	78	50	78		70	70		ROOM	LIGHT30	NO
35	78	50	78		70	70		ROOM	LIGHT30	NO
40	78	50	78		70	70		ROOM	LIGHT30	NO
45	78	50	78		70	70		ROOM	LIGHT30	NO
50	78	50	78		70	70		ROOM	LIGHT30	NO
55	78	50	78		70	70		ROOM	LIGHT30	NO
60	78	50	78		70	70		ROOM	LIGHT30	NO
65	78	50	78		70	70		ROOM	LIGHT30	NO
70	78	50	78		70	70		ROOM	LIGHT30	NO
75	78	50	78		70	70		ROOM	LIGHT30	NO
80	78	50	78		70	70		ROOM	LIGHT30	NO
85	78	50	78		70	70		ROOM	LIGHT30	NO
90	78	50	78		70	70		ROOM	LIGHT30	NO
95	78	50	78		70	70		ROOM	LIGHT30	NO
100	78	50	78		70	70		ROOM	LIGHT30	NO
105	78	50	78		70	70		ROOM	LIGHT30	NO

Card 22				Roof Par	ameters				
		Roof							
Room	Roof	Equal to	Roof	Roof	Roof	Const	Roof	Roof	Roof
Number	Number	Floor?	Length	Width	U-Value	Type	Direction	Tilt	Alpha
5	1 19		59	60	.08	26	0	90	.74

YES

YES

YES

Card 22----- Roof Parameters ------Roof Room Roof Equal to Roof Roof Roof Const Roof Roof Roof Number Number Floor? Length Width U-Value Type Direction Tilt Alpha .08 .74 .08 .74 .08 .74 .08 .74 .08 .74 .08 .74 .08 .74 .74 .08 .08 .74 .08 .74 .08 .74 .08 .74 .08 .74 .08 .74 .08 .74 YES .07 .9 YES .07 .9

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Card 24	,		•••••	Wall P	arameters				
					Wall				Ground
Room	Wall	Wall	Wall	Wall	Constuc	Wall	Wall	Wall	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
5	1	275	9.5	.11	58	0		.74	
5	2	108	9.5	.11	58	90		.74	
5	3	275	9.5	.11	58	180		.74	
5	4	108	9.5	.11	58	270		.74	
10	1	275	9.5	.11	58	0		.74	
10	2	108	9.5	.11	58	90		.74	
10	3	275	9.5	.11	58	180		.74	
10	4	108	9.5	.11	58	270		.74	
15	1	275	9.5	.11	58	0		.74	
15	2	108	9.5	.11	58	90		.74	
15	3	275	9.5	.11	58	180		.74	
15	4	108	9.5	.11	58	270		.74	
20	1	275	9.5	.11	58	0		.74	
20	2	108	9.5	.11	58	90		.74	
20	3	275	9.5	.11	58	180		.74	
20	4	108	9.5	.11	58	270		.74	
25	1	275	9.5	.11	58	0		.74	
25	2	108	9.5	-11	58	90		.74	
25	3	275	9.5	.11	58	180		.74	

					Wall				
Room	Wall Number	Wall	Wall Height	Wall U-Value	Constuc		Wall		Reflectanc Multiplier
lumber	Number 4	Length	9.5	.11	Type 58	270	1111	•	Multiplier
25	1	108 275	9.5	.11		0		.74 .74	
50	2	108	9.5	.11	58	90			
50	3			.11	58			.74	
30 30	4	275 108	9.5		58	180		.74	
35	1		9.5	.11	58	270 0		.74	
	2	275	9.5	.11	58	90		.74	
35 35		108	9.5	.11	58			.74	
	3	275	9.5	.11	58	180		.74	
35	4	108	9.5	.11	58	270		.74	
10	1	275	9.5	.11	58	90		.74	
40	2	108	9.5	.11	58	180		.74	
40	3	275	9.5	.11	58	270		.74	
40	4	108	9.5	.11	58	0		.74	
45	1	275	9.5	.11	58	90		.74	
45	2	108	9.5	.11	58	180		.74	
45	3	275	9.5	.11	58	270		.74	
45	4	108	9.5	.11	58	0		.74	
50	1	275	9.5	.11	58	90		.74	
50	2	108	9.5	.11	58	180		.74	
50	3	275	9.5	.11	58	270		.74	
50	4	108	9.5	.11	58	0		.74	
55	1	275	9.5	.11	58	90		-74	
55	2	108	9.5	.11	58	180		.74	
55	3	275	9.5	.11	58	270		.74	
55	4	108	9.5	.11	58	0		.74	
60	1	275	9.5	-11	58	90		.74	
60	2	108	9.5	-11	58	180		.74	
60	3	275	9.5	-11	58	270		.74	
60	4	108	9.5	.11	58	0		.74	
65	1	275	9.5	-11	58	90		.74	
65	2	108	9.5	-11	58	180		.74	
65	3	275	9.5	.11	58	270		.74	
65	4	108	9.5	.11	58	0		.74	
70	1	275	9.5	.11	58	90		.74	
70	2	108	9.5	.11	58	180		.74	
70	3	275	9.5	.11	58	270		.74	
70	4	108	9.5	•11	58	0		.74	
75	1	275	9.5	.11	58	90		.74	
75	2	108	9.5	.11	58	180		.74	
75	3	275	9.5	.11	58	270		.74	
75	4	108	9.5	.11	58	0		.74	
80	1	275	9.5	.11	58	90		.74	
80	2	108	9.5	.11	58	180		.74	
80	3	275	9.5	.11	58	270		.74	
80	4	108	9.5	.11	58	0		.74	
85	1	46	10	.10	58	0		.74	
85	2	46	10	.10	58	90		.74	

					Wall				Ground
Room	Wall	Wall	Wall	Wall	Constuc	Wall	Wall	Wall	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
85	3	46	10	.10	58	180		.74	
85	4	46	10	.10	58	270		.74	
90	1	46	10	.10	58	0		.74	
90	2	46	10	.10	58	90		.74	
90	3	46	10	.10	58	180		.74	
90	4	46	10	.10	58	270		.74	
95	1	46	10	.10	58	0		.74	
95	2	46	10	.10	58	90		.74	
95	3	46	10	.10	58	180		.74	
95	4	46	10	.10	58	270		.74	
100	1	46	10	.10	58	0		.74	
100	2	46	10	.10	58	90		.74	
100	3	46	10	.10	58	180		.74	
100	4	46	10	.10	58	270		.74	
105	1	188	13	.21	52	0		.9	
105	2	188	13	.21	52	180		.9	
105	3	125	13	.21	52	270		.9	

				Pct Glass			External	Internal	Percent		Inside
Room	Wall	Glass	Glass	or No. of	Glass	Shading	Shading	Shading	Solar to	Visible	Visible
Number	Number	Length	Width	Windows	U-Value	Coefficient	Type	Type	Ret. Air	Transmittance	Reflectance
10	1	4	2	54	1.1	.67					
10	3	4	2	54	1.1	.67					
15	1	4	2	54	1.1	.67					
15	3	4	2	54	1.1	.67					
20	1	4	2	54	1.1	.67					
20	3	4	2	54	1.1	.67					
25	1	4	2	54	1.1	.67					
25	3	4	2	54	1.1	.67					
30	1	4	2	54	1.1	.67					
35	3	4	2	54	1.1	.67					
40	1	4	2	54	1.1	.67					
45	3	4	2	54	1.1	.67					
50	1	4	2	54	1.1	.67					
50	3	4	2	54	1.1	.67					
55	1	4	2	54	1.1	.67					
55	3	4	2	54	1.1	.67					
60	1	4	2	54	1.1	.67					
60	3	4	2	54	1.1	.67					
65	1	4	2	54	1.1	.67					
65	3	4	2	54	1.1	.67					
70	1	4	2	54	1.1	.67					
70	3	4	2	54	1.1	.67					
75	1	4	2	54	1.1	.67				•	

Percent Percent Inside Percent Percen	
Number Humber Length Width Uindows U-Value Coefficient Type Type Ret. Air Transmittance Reflectance 75 3 4 2 54 1.1 .67 .67 .67 .67 .67 .67 .67 .67 .67 .67 .67 .67 .85 2 8 4 2 1.1 .67 3 .67	
75	
80 1 4 2 54 1.1 .67 80 3 4 2 54 1.1 .67 85 1 8 10 1 1.1 .67 85 2 8 4 2 1.1 .67 3 85 4 8 4 2 1.1 .67 3 90 1 8 10 1 1.1 .67 3 90 2 8 4 2 1.1 .67 3 90 4 8 4 2 1.1 .67 3	:e
80 3 4 2 54 1.1 .67 85 1 8 10 1 1.1 .67 85 2 8 4 2 1.1 .67 3 85 4 8 4 2 1.1 .67 3 90 1 8 10 1 1.1 .67 3 90 2 8 4 2 1.1 .67 3 90 4 8 4 2 1.1 .67 3	
85 1 8 10 1 1.1 .67 85 2 8 4 2 1.1 .67 3 85 4 8 4 2 1.1 .67 3 90 1 8 10 1 1.1 .67 3 90 2 8 4 2 1.1 .67 3 90 4 8 4 2 1.1 .67 3	
85	
85	
90 1 8 10 1 1.1 .67 3 90 2 8 4 2 1.1 .67 3 90 4 8 4 2 1.1 .67 3	
90 2 8 4 2 1.1 .67 3 90 4 8 4 2 1.1 .67 3	
90 4 8 4 2 1.1 .67 3	
05 1 R 10 1 11 47 7	
20 10 10 1 1.1 .07 3	
95 2 8 4 2 1.1 .67 3	
95 4 8 4 2 1.1 .67 3	
100 1 8 10 1 1.1 .67 3	
100 2 8 4 2 1.1 .67 3	
100 4 8 4 2 1.1 .67 3	
105 1 2 4 7 1.1 .67	
105 2 2 4 7 1.1 .67	
105 3 2 4 2 1.1 .67	

Room					Reheat	Cooling	Heating	Auxiliary	Room	Daylighting
Number	People	Lights	Ventilation	Infiltration	Minimum	Fans	Fan	Fan	Exhaust	Controls
5	FSHBARRP	FSHBARRL								
10	FSHBARRP	FSHBARRL								
15	FSHBARRP	FSHBARRL								
20	FSHBARRP	FSHBARRL								
25	FSHBARRP	FSHBARRL								
30	FSHBARRP	FSHBARRL								
35	FSHBARRP	FSHBARRL								
40	FSHBARRP	FSHBARRL								
45	FSHBARRP	FSHBARRL								
50	FSHBARRP	FSHBARRL								
55	FSHBARRP	FSHBARRL								
60	FSHBARRP	FSHBARRL								
65	FSHBARRP	FSHBARRL								
70	FSHBARRP	FSHBARRL								
75	FSHBARRP	FSHBARRL								
80	FSHBARRP	FSHBARRL								
85	FSHOFFIC	FSHOFFIC								
90	FSHOFFIC	FSHOFFIC								
95	FSHBARRP	FSHBARRL								
100	FSHBARRP	FSHBARRL								
105	FSHOFFIC	FSHOFF1C								

							Lighting		Percent	Daylig	hting
Room	People	People	People	People	Lighting	Lighting	Fixture	Ballast	Lights to	Reference	Reference
Number	Value	Units	Sensible	Latent	Value	Units	Туре	Factor	Ret. Air	Point 1	Point 2
5	53	PEOPLE	250	200	1	WATT-SF	INCAND				
10	53	PEOPLE	250	200	1	WATT-SF	INCAND				
15	53	PEOPLE	250	200	1	WATT-SF	INCAND				
20	53	PEOPLE	250	200	1	WATT-SF	INCAND				
25	53	PEOPLE	250	200	1	WATT-SF	INCAND				
30	53	PEOPLE	250	200	1	WATT-SF	INCAND				
35	53	PEOPLE	250	200	1	WATT-SF	INCAND				
40	53	PEOPLE	250	200	1	WATT-SF	INCAND				
45	53	PEOPLE	250	200	1	WATT-SF	INCAND				
50	53	PEOPLE	250	200	1	WATT-SF	INCAND				
55	53	PEOPLE	250	200	1	WATT-SF	INCAND				
60	53	PEOPLE	250	200	1	WATT-SF	INCAND				
65	53	PEOPLE	250	200	1	WATT-SF	INCAND				
70	53	PEOPLE	250	200	1	WATT-SF	INCAND				
75	53	PEOPLE	250	200	1	WATT-SF	INCAND				
80	53	PEOPLE	250	200	1	WATT-SF	INCAND				
85	10	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
90	10	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
95	10	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
100	10	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
105	96	PEOPLE	250	200	2.75	WATT-SF	ASHRAE2				

	Misc		Energy	Energy		Energy	Percent	Percent	Percent		
Room	Equipment	Equipment	Consump	Consump	Schedule	Meter	of Load	Misc. Load		Radiant	Optional
Number	Number	Descrip	Value	Units	Code	Code					•
5	1	BARREQ				rode	Sensible	to Room	to Ret. Air	Fraction	Air Path
10	:		.75	WATT-SF	FSHBARRL						
	1	BARREQ	.75	WATT-SF	FSHBARRL						
15	1	BARREQ	.75	WATT-SF	FSHBARRL						
20	1	BARREQ	.75	WATT-SF	FSHBARRL						
25	1	BARREQ	.75	WATT-SF	FSHBARRL						
30	1	BARREQ	.75	WATT-SF	FSHBARRL						
35	1	BARREQ	.75	WATT-SF	FSHBARRL						
40	1	BARREQ	.75	WATT-SF	FSHBARRL						
45	1	BARREQ	.75	WATT-SF	FSHBARRL						
50	1	BARREQ	.75	WATT-SF	FSHBARRL						
55	1	BARREQ	.75	WATT-SF	FSHBARRL						
60	1	BARREQ	.75	WATT-SF	FSHBARRL						
65	1	BARREQ	.75	WATT-SF	FSHBARRL						
70	1	BARREQ	.75	WATT-SF	FSHBARRL						
75	1	BARREQ	.75	WATT-SF	FSHBARRL						
80	1	BARREQ	.75	WATT-SF	FSHBARRL						
85	1	COMPUTER	1	WATT-SF	FSHOFFIC						
90	1	COMPUTER	1	WATT-SF	FSHOFFIC						
95	1	COMPUTER	1	WATT-SF	FSHBARRL						
100	1 9	COMPUTER	1	WATT-SF	FSHBARRL						
105	1. 9	COMPUTER	1	WATT-SF	FSHOFFIC		•				

)	Vanti	lation	•••••						
Room									Reheat	
	Value		Value							
5	value	units	value	Units			Value	Units	Value	Units
					1440	CFM	1440	CFM		
10					1440	CFM	1440	CFM		
15					1440	CFM	1440	CFM		
20					1440	CFM	1440	CFM		
25					1440	CFM	1440	CFM		
30					1440	CFM	1440	CFM		
35					1440	CFM	1440	CFM		
40					1440	CFM	1440	CFM		
45					1440	CFM	1440	CFM		
50					1440	CFM	1440	CFM		
55					1440	CFM	1440	CFM		
60					1440	CFM	1440	CFM		
65					1440	CFM	1440	CFM		
70					1440	CFM	1440	CFM		
75					1440	CFM	1440	CFM		
80					1440	CFM	1440	CFM		
85	340	CFM	340	CFM						
90	340	CFM	340	CFM						
95	340	CFM	340	CFM						
100	340	CFM	340	CFM						
105	3580	CFM	3580	CFM						

	••••	Ha	in			Auxi	liary			
Room	Coo	ling	Hea	ting	Coo	ling	Hea	ting	Room E	xhaust-
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
5									1440	CFM
10									1440	CFM
15									1440	CFM
20									1440	CFM
25									1440	CFM
30									1440	CFM
35									1440	CFM
40									1440	CFM
45									1440	CFM
50									1440	CFM
55									1440	CFM
60									1440	CFM
65									1440	CFM
70									1440	CFH
75									1440	CFM
80									1440	CFM
85									325	CFM
90									325	CFM
95						•			325	CFM

Card 30											
		Main-				Auxili	ary				
Room	Cooli	-	Heating		Coolir	ng	Heating-		-Room I	Exhaust	
Number 100	Value	Units V	'alue Ui	nits V	alue	Units	Value Uni	32	alue 25	Units CFM	
105								85	50	CFM	
Card 31			Da	ctition D	aramatara		•••••				
Room			Partition								
Number	Number	Length	Height	U-Valu		-	Temp	Temp	Room		
105	1	125	13	.09	101		•				
caad 37				5	1						
.aru 33							FINS				
		Height				Left	1149	Right		Adjacent	
Shading		-	jection G	lass Pro	jection		n Projection				
Type	Height			idth Lef		Out	Right	Out		Flag	
3	8	1 7	4	.5		7	.5	7		•	
Card 39 Number		lternative scription									
1	EX	ISTING BUIL	DINGS								
Card 40			System	Туре			•••••				
			OPTIONAL	VENTILAT	ION SYSTE	M	••••				
System		Ventil					Fan				
Set	System		Cooling H	_	_	Heating					
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System											
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ard 7	1		•••••	Ba	se Utility	y Paramete	ers					•••		
ase	Base		Hourl				Equi		emand					
tilit	y Utility	,	Demar	nd Deman	d Schedul	le Energy	/ Refe	erence L	imiting	Entering	Leav	ing		
lumber	Descrip	•	Value	Units	Code	Type	Numb	er N	lumber	Тетр	Тетр	•		
		-LINE LOS		MBH	AVAIL	HOT-LO	1							
2	HT-PUMP	LOSS CHL	33.4	TONS	FTSAMC	LG CHILL-	LD 1							
ard 7	4		•••••	Condens	er / Cooli	ina Tower	Paramete	.re						
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	H1-PU	MP LOSS CHL	33.4	TONS	FTSANCLG	CHIEL-LD	1						
	Cooling			Energy	Energy			Number	Doccon		بيماهاس	Smd	
ef	Tower Code EQ5100		Capacity Units	Consump Value	Consump	Fluid Type		Of	Airflo	t Low Sp w Energy d Value	Ene	rgy	
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	Equip		CO				HEAT				Seq		Demand
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	Name YSCRW22	1	/alue Units	Value 186	Units KW	Value	Units	Val	ue U	nits	Num	Туре	Number
			CONDI							••••••			
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m	Value	Units	Value	Units	Value	Units	Co	ntrol S	Storage	Tower	Access.		
	18.65	KW	11.19	KW						1			
·d	71 Base		Hourly	Hourly	Utility P	arameters	Equip		nand	•••••		•	
ili	ty Utili	ty	Demand	•	Schedul e	Energy				Entering	Leaving		
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ier f	Cooling Tower Code EQ5100	Capaci Value	ity Capacity	Consump Value 11.19	Consump Units KW	Fluid Type	Туре	Of Cells 1	Airflo	w Energy	Ener	gy	
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	quip	Num	co	OLING	•••••		HEAT R	ECOVERY-	• • • • • • •		Seq		Demar
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ium M	ame CENT123		Value Units	Value 177	Units KW	Value	Units	Value	Uni	ts	Num	Туре	Numbe
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1	8.65	KW	11.19	KW					1				
lase	Base y Utilit Descri	y P	Hourly Demand Value CHL 33.4	Hourly Demand Units	Schedul e Code	Parameters Energy Type CHILL-LD	Equip Referenc Number	Deman	d ing En	itering	Leavir Temp	- ng	

et		Reat Fan	Return Fan	Mn Exh Fan	Aux Fan		Cool Fan Mtr	Return Fan Mtr		Suppl Duct	y Return Air	1			
mber	SP .75	SP .75	SP	SP	SP	SP	Loc	Loc	Ht Gn	Loc	Path				
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	Main			Direc			Auxiliary		Mai					liary	
t	Cooli			Evap		Evap	Cooling	Heating	Pre	heat	Reheat	Mech.	Heat	ing	
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	FTSAM	CLG						FTSAMH'	rg FTS	AMHTG	FTSAMHTG				
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oad / sgn lef card 60 cool E tef C	All Coi Loads T Cool Re 1	t Co o Equ of Si BL	oling uipment zing KPLANT Ca ts Valu 304	-Group Begin E 1 1 pacity e Units TONS	1 nd B	Group 2- legin End Coo NG Value 225	-Group 3- Begin End Ling Equip Units KW	-Group Begin E ment Pare Capac Value	4Gr nd Beg meters HEAT ity Units	roup 5- in End RECOVE	-Group Begin E RY RYEnergy- lue Un	6Ground Begin	p 7- End Seq Order Num	-Group Begin Seq	8Gro End Begi Demand Limit
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oad / Sagn Sag	All Coi Loads T Cool Re 1 2 quip code lame 91001s	l Coo o Equif Si BLI Num Of Uni 1	oling uipment zing KPLANT Ca ts Valu 304	-Group Begin E 1 1 pacity e Units TONS	11 COOLI	Group 2- legin End Coo NGEner Value 225 Cooling Pu	-Group 3- Begin End Ling Equip Units KW mps and ReHT REC	-Group Begin E ment Para Capac Value	4Gr nd Beg meters HEAT ity Units	roup 5- in End RECOVE Va	-Group Begin E RY RYEnergy- lue Un	6Ground Begin	p 7- End Seq Order Num	-Group Begin Seq Type	8Gro End Begi Demand
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umber Schedule Schedule Max KW Alternative Description Schedule Drift W. C. V.F.D. CENTR. CHILLER, EXIST BOILR ard 60														••••	•••	
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		D WATER		-					•••••		
Ref Num		Full Load Units		Full Load Units	full Lo	ad Full t	vo beo.	er		Cooling Tower	Misc. Access.
Card Base	71 Base		Hourly		Utility P		Equip		emand		
Jtili	ty Utili	•	Demand		Schedule	Energy	Refere		-	Entering	Leaving
Numbe	r Descr	ip	Value	Units	Code	Type	Number	· N	umber	Temp	Temp
1	HT-PU	MP LOSS CHL	33.4	TONS	FTSAMCLG	CHILL-LD	1				
Card	74			Condenser	/ Cooling	Touer Pa	rameters				
	Cooling			Energy	Energy					nt Low Sp	
Tower	Tower	Capacity		Consump	Consump	Fluid	Tower			ow Energy	
Ref	Code	Value	Units	Value	Units	Type	Type	Cells	LOW S	pd Value	Units
1	EQ5100			11.19	KW			1			

...... ** TRACE 600 ANALYSIS ** ** by HUITT & ZOLLARS

> 030185.04 EEAP BOILER-CHILLER STUDY FT. SAM HOUSTON - SAN ANTONIO, TX. CORPS. OF ENGINEERS - FORT WORTH, TX. HUITT-ZOLLARS INC.

AREA 900

Weather File Code:

Barometric Pressure:

Winter Ground Relectance:

Location:	SAN ANTONIO, TEXAS
Latitude:	29.0 (deg)
Longitude	98.0 (den)

98.0 (deg) Time Zone: 6 792 (ft) Elevation:

29.0 (in. Hg)

Summer Clearness Number: 0.90 Winter Clearness Number: 0.90 Summer Design Dry Bulb: 97 (F) 76 (F) Summer Design Wet Bulb: Winter Design Dry Bulb: 30 (F) Summer Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft) Air Specific Heat: 0.2444 (Btu/lbm/F) Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F) 4,761.9 (Btu-min./hr/cuft) Latent Heat Factor: Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

0.20

Design Simulation Period: June To November System Simulation Period: January To December Cooling Load Methodology: TETD/Time Averaging

14:25:17 5/31/95 Time/Date Program was Run: Dataset Name: FSH900 .TM

STEM TOTALS LOAD PROFILE - ALTERNATIVE 1

SYSTEM LOAD PROFILE -----

System Totals

Percent	Cooli	ing Loa	d	Heatir	g Load	
Design	Cap.	Hours	Hours	Capacity	Hours	Hours
Load	(Ton)	(%)		(Btuh)	(%)	
0 - 5	15.5	7	276	-127,751	41	728
5 - 10	31.0	8	317	-255,502	24	432
10 - 15	46.5	8	313	-383,253	11	199
15 - 20	62.0	7	288	-511,003	8	146
20 - 25	77.5	8	307	-638,754	5	89
25 - 30	93.0	9	353	-766,505	4	79
30 - 35	108.5	6	257	-894,256	4	76
35 - 40	124.0	4	168	-1,022,007	1	16
40 - 45	139.5	5	202	-1,149,758	1	16
45 - 50	155.0	4	173	-1,277,509	0	0
50 - 55	170.5	5	207	-1,405,259	0	0
55 - 60	186.0	6	235	-1,533,010	0	0
60 - 65	201.5	5	188	-1,660,761	0	0
45 - 70	217.0	4	143	-1,788,512	0	0
- 75	232.5	3	124	-1,916,263	0	0
75 - 80	247.9	4	147	-2,044,014	0	0
80 - 85	263.4	8	332	-2,171,765	0	0
85 - 90	278.9	0	0	-2,299,516	0	0
90 - 95	294.4	0	0	-2,427,266	0	0
95 - 100	309.9	0	0	-2,555,017	0	0
Hours Off	0.0	0	4,730	0	0	6,979

JIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

Ť	Equip	•				Mon	thly cons	sumption						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
0	LIGHTS													
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,69
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD										•			
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
				EUTILITY										
	HOTLD	4525	4087	4525	4379	4525	4379	4525	4525	4379	4525	4379	4525	53,2
	PK	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
				UTILITY										
	CHILLD	0	0	0	0	24850	24048	24850	24850	24048	24850	0	0	147,4
	PK	0.0	0.0	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	33
	EQ1001S						<550 TON:	s						
	ELEC	0	0	0	0	62585	78816	95844	100025	69899	36888	0	0	444,0
	PK	0.0	0.0	0.0	0.0	202.4	202.7	223.5	225.8	208.0	115.8	0.0	0.0	225
	EQ5100			LING TOWE										
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	4420	0	0	45,5
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	1

IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

SE CASE

•••			•••••	E Q	UIPI	MENT	ENEI	RGY	ONSU	JMPT	I O N			
tef	Equip					Mon	thly Con:	sumption						
	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5100		COOL	ING TOWE	R FANS									
	WATER	0	0	0	0	337	432	526	544	381	183	0	0	2,403
	PK	0.0	0.0	0.0	0.0	1.2	1.1	1.2	1.2	1.1	0.7	0.0	0.0	1.2
1	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5010		COND	ENSER WA	TER PUM	P-CV(HIG	H EFFIC.)						
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300		CONT	ROL PANE	L & INT	ERLOCKS					*			
	ELEC	0	0	0	0	744	720	744	744	720	744	0	O	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1			NATU	JRAL DRAF	T, WATE	R TUBE B	OILER							
	GAS	7875	7951	6205	5921	6115	5918	6115	6115	5918	6115	6024	7815	78,086
	PK	19.1	22.5	10.2	8.8	8.2	8.2	8.2	8.2	8.2	8.2	10.1	19.7	22.5
1	EQ5013		WATE	R CIRCUL	ATING P	UMP - CO	NSTANT V	OLUME						
	ELEC	2775	2507	2775	2686	2775	2686	2775	2775	2686	2775	2686	2775	32,675
	PK	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
1	EQ5311		BOIL	LER CONTR	OLS									
	ELEC	93	84	93	90	93	90	93	93	90	93	90	93	1,095
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1	EQ5013		WATE	ER CIRCUL	ATING P	UMP - CO	NSTANT V	OLUME						
	ELEC	2775	2507	2775	2686	2775	2686	2775	2775	2686	2775	2686	2775	32,675
	PK	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
1	EQ5013		WATE	ER CIRCUL	ATING P	UMP - CO	NSTANT V	OLUME						
	ELEC	1109	1001	1109	1073	1109	1073	1109	1109	1073	1109	1073	1109	13,052
	PK	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
1	EQ5013		WATI	ER CIRCUL	ATING P	UMP - CO	NSTANT V	OLUME						
	ELEC	833	753	833	806	833	806	833	833	806	833	806	833	9,811
	PK	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2			NATI	URAL DRAF	T, WATE	R TUBE B	OILER							
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ef	Equip	• • • • • • • • • •	• • • • • • • •			Mon	thly Cons	sumption		*******				
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS										•			
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,698
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
3	MISC LD											•		
	OIL	0	0	0	0	0	0	0	o	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1				E UTILIT										
	CHILLD	0	0	0	0	24850	24048	24850	24850	24048	24850	0	0	147,49
	PK	0.0	0.0	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	33.
1				K ENGINE										,
	GAS	0	0	0	0	4756	5968	7287	7671	5326	2853	0	0	33,86
	PK	0.0	0.0	0.0	0.0	16.1	15.6	18.7	19.6	16.0	8.1	0.0	0.0	19.
1	EQ5100	-		LING TOW										
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	4262	0	0	45,35
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11
1	EQ5100	_		LING TOW										
	WATER	0	0	0	0	365	467	569	591	412	200	0	0	2,60
	PK	0.0	0.0	0.0	0.0	1.3	1.2	1.4	1.4	1.2	0.8	0.0	0.0	1.

'HPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 3 ENGINE DRIVEN CHILLER, EXIST. BOILER

Ref	Equip		• • • • • • • • • • • • • • • • • • • •		• • • • • • •	Mon	thly Cons	sumption						
Num	Code	Jan	Feb	Har	Apr	May	June	July	Aug	\$ep	0ct	Nov	Dec	Total
1	EQ5001		CHIL	LED WATE	R PUMP -	CONST	ANT VOLUM	ME						
	ELEC	0	0	0	C	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5011		COND	ENSER WA	TER PUMP	-CV(MED	IUM EFFI	C.)						
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	E05300		CONT	ROL PANE	L & INTE	RLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

Trane Air Conditioning Economics
By: HUITT & ZOLLARS

"JIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
"ER COOLED SCREW CHILLER, EXIST BOILER

•••••		••••••	O N	MPTI	ONSU	G Y C	ENER	ENT	UIPH	E Q	•••••			
			•••••		• • • • • • •	umption	hly Cons	Mont	•••••	•••••			Equip -	Ref
Tot	Dec	Nov	Oct	Sep	Aug	July	June	May	Apr	Mar	Feb	Jan	Code	Num
													LIGHTS	0
503,6	42375	41473	42825	41391	42866	42743	41473	42825	41391	42866	38686	42784	ELEC	
152	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	PK	
													MISC LD	1
	0	0	0	0	0	0	0	0	0	0	0	0	ELEC	
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	PK	
													MISC LD	2
	0	0	0	0	0	0	0	0	0	0	0	0	GAS	
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	PK	
													MISC LD	3
	0	O	0	0	0	0	0	0	0	0	0	0	011	
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	PK	
													MISC LD	4
	0	0	0	0	0	0	0	0	0	0	0	0	P STEAM	
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	PK	
													MISC LD	5
	0	0	0	0	0	0	0	0	0	0	0	0	P HOTH20	
(0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	PK	
													MISC LD	6
	0	0	0	0	0	0	0	0	0	0	0	0	P CHILL	
(0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	PK	
									4	UTILIT	BASE			1
147,4	0	0	24850	24048	24850	24850	24048	24850	0	0	0	G	CHILLD	
33	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	0.0	0.0	PK	
								LL.	CREW CHI	k w.c. s	YOR		YSCRW22	1
317,	0	0	28993	48770	70890	67754	56032	44600	0	0	0	0	ELEC	
184	0.0	0.0	76.2	154.6	184.9	176.9	150.3	163.7	0.0	0.0	0.0	0.0	PK	
										LING TOW			EQ5100	1
45,	0	0	4354	8057	8325	8325	8057	8325	0	0	0	0	ELEC	
1	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	0.0	0.0	PK	
										LING TOW			EQ5100	1
2,	0	0	175	361	518	501	411	320	0	0	0	0	WATER	
	0.0	0.0	0.7	1.1	1.2	1.2	1.1	1.2	0.0	0.0	0.0	0.0	PK	

Trane Air Conditioning Economics
By: HUITT & ZOLLARS

TOUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3 /ER COOLED SCREW CHILLER, EXIST BOILER

				E Q	UIPN	LENT	ENE	RGY	соиси	JMPT	I O N			
Ref	Equip					Mon	thly Cons	sumption					• • • • •	
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001		CHIL	LED WATER	R PUMP -	CONST	ANT VOLU	4E						gr. segarrizati name
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5011		COND	ENSER WA	TER PUMP	P-CV(MED	IUM EFFI	C.)						
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300		CONT	ROL PANE	L & INTE	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	Ō	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

TIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
. C. R-123 CENTR. CHILLER, EXIST BOILER

ef	Equip		• • • • • • • • •			Mon1	thly Cons	sumption						
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
0	LIGHTS													
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,69
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	Ö	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
2	MISC LD													
	GAS	0	0	0	0	0	O	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
3	MISC LD										,			
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1			BAS	E UTILIT	Y									
	CHILLD	0	0	0	0	24850	24048	24850	24850	24048	24850	0	0	147,49
	PK	0.0	0.0	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	33
1				K CENT.										
	ELEC	0	0	0	0	45712	56332	67955	70957	50302	28814	0	0	320,0
	PK	0.0	0.0	0.0	0.0	155.7	143.0	168.4	175.9	147.1	80.7	0.0	0.0	175
1	EQ5100			LING TOW										
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	4351	0	0	45,4
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11
ì	EQ5100			LING TOW									•	
	WATER	0	0	0	0	321	411	501	518	363	175	0	0	2,2
	PK	0.0	0.0	0.0	0.0	1.2	1.1	1.2	1.2	1.1	0.7	0.0	0.0	1

C. R-123 CENTR. CHILLER, EXIST BOILER

			•••••	E Q	UIP	ENT	ENE	RGY	соиѕі	JMPT	ON	• • • • • • • • • • • • • • • • • • • •	••••••	
Ref	Equip					Mon	thly Cons	sumption						
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001		CHIL	LED WATER	R PUMP -	CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5011		COND	ENSER WA	TER PUM	-CV(MED	IUM EFFI	c.)						
	ELEC	0	0	0	0	8325	8057	8325	.8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300		CONT	ROL PANE	L & INTE	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

TIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
. C. V.F.D. CENTR. CHILLER, EXIST BOILR

------ EQUIPMENT ENERGY CONSUMPTION ------Ref Equip ------ Monthly Consumption -----Mar Aug Sep Num Code Jan Feb Apr May June July Oct Nov Total O LIGHTS ELEC 42784 38686 42866 41391 42825 41473 42743 42866 41391 42825 41473 42375 503.698 PK 152.0 152.0 152.0 152.0 152.0 152.0 152.0 152.0 152.0 152.0 152.0 152.0 152.0 1 MISC LD ELEC 0 0 0 0 n n n n n n ٥ n O PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 2 MISC LD GAS n 0 n n 0 0 O 0 0 0 0 0 0 PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 3 MISC LD OIL 0 Ö 0 0 Ō 0 0 PΚ 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 4 MISC LD P STEAM 0 0 0 0 0 0 0 n 0 n n n 0 PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 5 MISC LD P HOTHZO n 0 0 n 0 Ō 0 0 0 0 0 0 0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 6 MISC LD P CHILL 0 ۵ 0 0 0 0 0 0 0 0 0 0 0 PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 BASE UTILITY CHILLD 0 0 0 0 24850 24048 24850 24850 24048 24850 n n 147,494 PK 0.0 0.0 0.0 0.0 33.4 33.4 33.4 33.4 33.4 33.4 0.0 0.0 33.4 1 YCENVFD YORK TURBO MODULATOR VAR. FREQ. DRIVE ELEC 0 O 0 0 40210 51150 45212 23500 289,309 62895 66342 0 0 PK 0.0 0.0 0.0 0.0 144.1 138.0 166.7 175.3 69.5 141.8 0.0 0.0 175.3 1 EQ5100 COOLING TOWER FANS ELEC D n 0 0 8325 8057 8325 8325 8057 4311 0 0 45,401 PK 0.0 0.0 0.0 0.0 11.2 11.2 11.2 11.2 11.2 11.2 0.0 0.0 11.2 1 EQ5100 COOLING TOWER FANS WATER 0 0 0 0 316 407 496 514 358 170 0 0 2,262 PK 0.0 0.0 0.0 0.0 1.2 1.0 1.2 1.2 1.1 0.7 0.0 0.0 1.2

TIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3

. C. V.F.D. CENTR. CHILLER, EXIST BOILR

				E Q	UIPN	ENT	ENE	R G Y (CONSI	JMPT	I O N			• • • • • • • • • • • • • • • • • • • •
Ref	Equip		•••••		• • • • • • • • • • • • • • • • • • • •	Mon	thly Con	sumption					•••••	
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E95001		CHIL	LED WATER	R PUMP -	CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5011	CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)												
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

IPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

ef	Equip					Mon	thly Con:	sumption						
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS	•												
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,698
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	O	0	0	0	0	0	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	Ō	0	0	0	1
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	,
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1				UTILIT										
	HOTLD	4525	4087	4525	4379	4525	4379	4525	4525	4379	4525	4379	4525	53,27
	PK	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.
1							ETUBE BO							
	GAS	6629	6694	5224	4985	5148	4982	5148	5148	4982	5148	5071	6579	65,73
	PK	16.1	19.2	8.6	7.4	6.9	6.9	6.9	6.9	6.9	6.9	8.5	16.6	19.
1	EQ5020			TING WAT										
	ELEC	2775	2507	2775	2686	2775	2686	2775	2775	2686	2775	2686	2775	32,67
	PK	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.
1	EQ5311			LER CONT										
	ELEC	93	84	93	90	93	90	93	93	90	93	90	93	1,09
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.

*IPMENT ENERGY CONSUMPTION - ALTERNATIVE 2IST CHILLER, FORCE DRAFT HIGH % BOILER

				E Q	UIPM	ENT	ENER	GY C	ONSU	MPTI	O N			•••••	
Ref	Equip					Mont	hly Cons	umption							
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total	
1	EQ5013		WATE	R CIRCUL	ATING PL	IMP - CON	ISTANT VO	LUME							
	ELEC	2775	2507	2775	2686	2775	2686	2775	2775	2686	2775	2686	2775	32,675	
	PK	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME													
	ELEC	1109	1001	1109	1073	1109	1073	1109	1109	1073	1109	1073	1109	13,052	
	PK	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
1	EQ5013		WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	833	753	833	806	833	806	833	833	806	833	806	833	9,811	
	PK	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	

01 Card - Job Information

Project: 03018504 BOILER-CHILLER STUDY Location: FT. SAM HOUSTON - SAN ANTONIO, TX. Client: CORPS OF ENGINEERS - FT. WORTH, TEXAS

Program User: HUITT - ZOLLARS INC. Comments: AREA 1300

Card 08------ Climatic Information ------Summer Winter Summer Winter Summer Winter Weather Clearness Clearness Design Design Building Ground Ground Code Number Number Dry Bulb Wet Bulb Dry Bulb Orientation Reflect Reflect SANANTON

Card 11----- Energy Simulation Parameters -----1st Month Last Month Level Building Energy Energy Of Holiday Calendar Floor Simulation Simulation Calculation Code Code Area ARHY 1994

. Load Section Alternative #1 -----

Card 19- Load Alternative -

Number Description

AREA 1300 EXISTING BUILDINGS

	Zone						Acoustic	Floor to	Duplicate	Duplicate	Perimete
Room	Reference	Room	Floor	Floor	Const	Plenum	Ceiling	Floor	Floors	Rooms per	Depth
Number	Number	Descrip	Length	Width	Type	Height	Resistance	Height	Multiplier	Zone	
5	5	ADMIN 1350	179	180	3	3	2.54	12.5			
10	10	DINING 1350	107	108	3	3	2.54	12.5			
15	15	KITCHEN 1350	69	69	3	3	2.54	12.5			
20	20	BARR 1350	398	399	3	3	2.54	12.5			
25	25	ADMIN 1374	100	100	3	4	2.54	13			
30	30	BARR 1374	240	240	3	4	2.54	13			
35	35	ADMIN 1375	100	100	3	4	2.54	13			
40	40	BARR 1375	240	240	3	4	2.54	13			
45	45	ADMIN 1379	100	100	3	4	2.54	13			

Card 20)			Gener	al Room	Paramete	rs				
	Zone						Acoustic	Floor to	Duplicate	Duplicate	Perimeter
Room	Reference	Room	Floor	Floor	Const	Plenum	Ceiling	Floor	Floors	Rooms per	Depth
Number	Number	Descrip	Length	Width	Type	Height	Resistance	Height	Multiplier	Zone	
50	50	BARR 1379	240	240	3	4	2.54	13			
55	55	ADMIN 1380	100	100	3	4	2.54	13			
60	60	BARR 1380	240	240	3	4	2.54	13			
65	65	BLDG. 1385	82	62	3	3.5	2.54	12			
70	70	ADMIN 1382	60	60	3	4	2.54	12			
75	75	BARR 1382	161	161	3	2	2.54	10.5			
80	80	KITCH 1377	100	100	3	3	2.54	12			
85	85	DIN 1377	116	116	3	3	2.54	12			

	Cooling	Room	Cooling	Cooling	Heating	Heating	Heating	T'stat	Mass /	Carpet
Room	Room	Design	T'stat	T'stat	Room	T'stat	T'stat	Location	No. Hrs	On
Number	Design DB	RH	Driftpoint	Schedul e	Design DB	Driftpoint	Schedule	Flag	Average	Floor
5	78	50	78		70	70		ROOM	LIGHT30	YES
10	78	50	78		70	70		ROOM	LIGHT30	NO
15	78	50	78		70	70		ROOM	LIGHT30	NO
20	78	50	78		70	70		ROOM	LIGHT30	NO
25	78	50	78		70	70		ROOM	LIGHT30	NO
30	78 .	50	78		70	70		ROOM	LIGHT30	NO
35	78	50	78		70	70		ROOM	LIGHT30	NO
40	78	50	78		70	70		ROOM	LIGHT30	NO
45	78	50	78		70	70		ROOM	LIGHT30	NO
50	78	50	78		70	70		ROOM	LIGHT30	NO
55	78	50	78		70	70		ROOM	LIGHT30	NO
60	78	50	78		70	70		ROOM	LIGHT30	NO
65	78	50	78		70	70		ROOM	LIGHT30	NO
70	78	50	78		70	70		ROOM	LIGHT30	NO
75	78	50	78		70	70		ROOM	LIGHT30	NO
80	78	50	78		70	70		ROOM	LIGHT30	NO
85	78	50	78		70	70		ROOM	LIGHT30	NO

		Roof							
Room	Roof	Equal to	Roof	Roof	Roof	Const	Roof	Roof	Roof
Number	Number	Floor?	Length	Width	U-Value	Type	Direction	Tilt	Alpha
5	1	NO	164	163	0.05	21			
10	1	YES			0.05	21			
15	1	YES			0.05	21			
20	1	NO	282	282	0.05	21			
25	1	NO	88	30	0.07	43			
30	1	NO	164	164	0.07	43			
35	1	NO	88	30	0.07	43			
40	1	NO	164	164	0.07	43			

Card 22	2			Roof Par	ameters	•••••			
		Roof							
Room	Roof	Equal to	Roof	Roof	Roof	Const	Roof	Roof	Roof
Number	Number	Floor?	Length	Width	U-Value	Type	Direction	Tilt	Alpha
45	1	NO	88	30	.07	43			
50	1	NO	164	164	0.07	43			
55	1	NO	83	30	0.07	43			
60	1	NO	164	164	0.07	43			
65	1	YES			0.08	47			
70	1	YES			0.07	37			
75	1	NO	114	114	0.07	37			
80	1	YES			0.11	47			
85	1	YES			0.11	47			

					Wall				Ground
Room	Wall	Wall	Wall	Wall	Constuc	Wall	Wall	Wall	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
5	1	128	12.5	.15	29	0			
20	1	1130	12.5	.15	29	0			
20	2	1400	12.5	.15	29	90			
20	3	1130	12.5	.15	29	180			
20	4	1400	12.5	.15	29	270			
25	1	88	13	.15	94	180			
25	2	40	13	.20	61	270			
25	3	40	13	.20	61	90			
30	1	912	13	.13	80	180		.74	
30	2	768	13	.13	80	270		.74	
30	3	912	13	.13	80	0		.74	
30	4	768	13	.13	80	90		.74	
35	1	88	13	.15	94	180			
35	2	40	13	.20	61	270			
35	3	40	13	.20	61	90			
40	1	912	13	.13	80	180		.74	
40	2	768	13	.13	80	270		-74	
40	3	912	13	.13	80	0		.74	
40	4	768	13	.13	80	90		.74	
45	1	88	13	.15	94	0			
45	2	40	13	.20	61	90			
45	3	40	13	.20	61	270			
50	1	912	13	.13	80	0		.74	
50	2	768	13	.13	80	90		.74	
50	3	912	13	.13	80	180		.74	
50	4	768	13	.13	80	270		.74	
55	1	88	13	.15	94	0			
55	2	40	13	.20	61	90			
55	3	40	13	.20	61	270			
60	1	912	13	.13	80	0		.74	
60	2	768	13	.13	80	90		.74	

Page #4

					Wall				Ground
Room	Wall	Wall	Wall	Wall	Constuc	Wall	Wall	Wall	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
60	3	912	13	.13	80	180		.74	
60	4	768	13	.13	80	270		.74	
65	1	82	12	.22	58	0			
65	2	62	12	.22	58	90			
65	3	82	12	.22	58	180			
65	4	62	12	.22	58	270			
70	1	44	12	.22	58	0			
70	2	52	12	.22	58	90			
70	3	68	12	.22	58	270			
75	1	360	10.5	.22	58	0			
75	2	312	10.5	.22	58	90			
75	3	412	10.5	.22	58	180			
75	4	312	10.5	.22	58	270			
80	1	62	12	.10	58	90			
80	2	32	12	.10	58	270			
85	1	82	12	.10	58	0			
85	2	160	12	.10	58	90			
85	3	82	12	.10	58	180			
85	4	124	12	.10	58	270			

				Pct Glass			External	Internal	Percent		Inside
moos	Wall	Glass	Glass	or No. of	Glass	Shading	Shading	Shading	Solar to	Visible	Visible
iumber	Number	Length	Width	Windows	U-Vatue	Coefficient	Type	Type	Ret. Air	Transmittance	Reflectance
5	1	4	5.5	12	.73	1					
20	1	4	5.5	272	.73	1	3				
20	2	4	5.5	84	.73	1	3				
20	3	4	5.5	272	.73	1	3				
20	4	4	5.5	84	.73	1	3				
25	1	4	7	16	1.1	.67	4				
30	1	2	4	144	1.1	.67	4				
30	2	2	4	72	1.1	.67	4				
30	3	2	4	116	1.1	.67	4				
30	4	2	4	72	1.1	.67	4				
35	1	4	7	16	1.1	.67	4				
40	1	2	4	144	1.1	.67	4				
40	2	2	4	72	1.1	.67	4				
40	3	2	4	116	1.1	.67	4				
40	4	2	4	72	1.1	.67	4				
45	1	4	7	16	1.1	.67	4				
50	1	2	4	144	1.1	.67	4				
50	2	2	4	72	1.1	.67	4				
50	3	2	4	116	1.1	.67	4				
50	4	2	4	72	1.1	.67	4				
55	1	4	7	16	1.1	.67	4				

Card 2	5	******			· ¥	lall∕Glass Par	ameters				• • • • • • • • • • • • • • • • • • • •
				Pct Glass			External	Internal	Percent		Inside
Room	Wall	Glass	Glass	or No. of	Glass	Shading	Shading	Shading	Solar to	Visible	Visible
Number	Number	Length	Width	Windows	U-Value	Coefficient	Type	Type	Ret. Air	Transmittance	Reflectance
60	1	2	4	144	1.1	.67	4				
60	2	2	4	72	1.1	.67	4				
60	3	2	4	116	1.1	.67	4				
60	4	2	4	72	1.1	.67	4				
65	1	4	4	8	1.1	1	5				
65	2	4	4	8	1.1	1	5				
65	3	4	4	6	1.1	1	5				
65	4	4	4	8	1.1	t	5				
70	1	5	3	7 ·	1.1	1					
70	2	5	3	1	1.1	1					
75	1	6	3	23	1.1	1					
75	2	6	3	16	1.1	1					
75	3	6	3	24	1.1	1					
75	4	6	3	14	1.1	1					
85	2	5	5	6	1.1	1					
85	4	5	5	6	1.1	1					

Card 26				S	chedules		•••••			
Room					Reheat	Cooling	Heating	Auxiliary	Room	Daylightin
Number	People	Lights	Ventilation	Infiltration	Minimum	Fans	Fan	Fan	Exhaust	Controls
5	FSHOFFIC	FSHOFFIC								
10	FSHDINP	FSHDINL								
15	FSHKITCH	FSHKITCH								
20	FSHBARRP	FSHBARRL								
25	FSHOFFIC	FSHOFFIC								
30	FSHBARRP	FSHBARRL								
35	FSHOFFIC	FSHOFFIC								
40	FSHBARRP	FSHBARRL								
45	FSHOFFIC	FSHOFF1C								
50	FSHBARRP	FSHBARRP								
5 5	FSHOFFIC	FSHOFFIC								
60	FSHBARRP	FSHBARRL								
65	FSHOFFIC	FSHOFFIC								
70	FSHOFFIC	FSHOFFIC								
75	FSHBARRP	FSHBARRL								
80	FSHKITCH	FSHK1TCH								
85	FSHDINP	FSHDINL								

Card 27	7				Peopl	e and Ligh	ts					
							Lighting		Percent	Daylig	hting	
Room	People	People	People -	People	Lighting	Lighting	Fixture	Ballast	Lights to	Reference	Reference	
Number	Value	Units	Sensible	Latent	Value	Units	Type	Factor	Ret. Air	Point 1	Point 2	
5	175	SF-PERS	250	200	2.25	WATT-SF	ASHRAE2					

							Light	ting		Percent	0:	aytig	hting	••	
loom	Peopl e	People	People -	People	Lighting	Lightin	g Fixtu	ure Bal	last	Lights t	Refere	ence	Reference		
lumber	Value	Units	\$ensible	Latent	Value	Units	Type	Fac	tor	Ret. Air	Point	1	Point 2		
10	300	PEOPLE	275	275	1.7	WATT-SF	ASHRA	AE2							
15	20	PEOPLE	275	475	1.5	WATT-SF	ASHRA	AE2							
20	1538	PEOPLE	250	200	1	WATT-SF	ASHRA	AE2							
25	35	SF-PERS	250	200	3.5	WATT-SF	ASHRA	AE2							
50	420	PEOPLE	250	200	2.6	WATT-SF	SUST	NCAN							
3 5	35	SF-PERS	250	200	3.5	WATT-SF	ASHRA	AE2							
0	420	PEOPLE	250	200	2.6	WATT-SF	SUSI	NCAN							
45	35	SF-PERS	250	200	3.5	WATT-SF	ASHR	AE2							
50	420	PEOPLE	250	200	2.6	WATT-SF	SUST	NCAN							
55	35	SF-PERS	250	200	3.5	WATT-SF	ASHR	AEZ							
60	420	PEOPLE	250	200	2.6	WATT-SF	SUSTI	NCAN							
65	16	PEOPLE	250	200	2.0	WATT-SF	ASHR	VE5							
70	8	PEOPLE	250	200	3.0	WATT-SF	ASHR	AE2							
75	232	PEOPLE	250	200	.65	WATT-SF	ASHR	VES.							
80	30	PEOPLE	250	200	2.6	WATT-SF	ASHR	AE2							
85	800	PEOPLE	250	200	1.22	WATT-SP	4000	453							
	8					Miscell	aneous	Equipment							
Card 2	8 Misc			En	ergy En	Miscell ergy	aneous	Equipment Energy	Perc	ent Per	cent	Perc	cent	Badlank	Ontion
Card 2 Room	8 Misc Equipm	ent Equi	pment	En Co	ergy En	Miscell ergy nsump Sch	aneous	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens	Radiant	•
Card 2 Room Number	8 Misc Equipm Number	ent Equi Desc	pment rip	En Co Va	ergy En nsump Co lue Un	Miscell ergy nsump Sch its Coo	aneous - - nedule	Equipment Energy	Perc of L	ent Per	cent c. Load	Perd	c. Sens	Radiant Fraction	•
Card 2 Room Number 5	8 Misc Equipm Number 1	ent Equi Desc COMP	pment rîp UTER	En Co Va 1	ergy En nsump Co lue Un WA	Miscell ergy nsump Sch its Coo IT-SF FSI	aneous nedule de doff10	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10	8 Misc Equipm Number 1	ent Equi Desc COMP DIN.	pment rip UTER EQPT.	En Co Va 1	ergy En nsump Co lue Un WA	Miscell ergy nsump Sch its Coo IT-SF FSH TT-SF FSH	aneous nedule de HOFFIC HOINL	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15	8 Misc Equipm Number 1 1	ent Equi Desc COMP DIN. KITC	pment rip UTER EQPT. HEN	Enc Co Va 1 1 1	ergy En nsump Co Lue Un WA WA	Miscellergy nsump Schits Coo TT-SF FSH TT-SF FSH	aneous nedule de HOFFIC HDINL	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15 20	8 Misc Equipm Number 1 1	ent Equi Desc COMP DIN. KITC	pment rip UTER EQPT. HEN TC.	En Co Va 1 1 16	ergy En nsump Coo Lue Un WA WA	Miscellergy nsump Sch its Coc IT-SF FSH IT-SF FSH IT-SF FSH	aneous inedule de HOFFIC HOINL HKITCH	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15 20 25	8 Misc Equipm Number 1 1 1	ent Equi Desc COMP DIN. KITC TV E	pment rip UTER EQPT. HEN TC.	En Co Va 1 1 16 1	ergy En- nsump Coo Lue Un WA WA WA	Miscell ergy nsump Sch its Coc IT-SF FSH IT-SF FSH IT-SF FSH IT-SF FSH IT-SF FSH	aneous inedule de de doffic do including de de de doffic do including de	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		Options Air Pat
Card 2 Room Number 5 10 15 20 25 30	8	ent Equi Desc COMP DIN. KITC TV E COMP	pment rip UTER EQPT. HEN TC. UTER APP.	En Co Va 1 1 16 1 1	ergy Ennsump Coolue Un WA WA WA WA	Miscell ergy nsump Sch its Coc it-SF FSI IT-SF FSI IT-SF FSI IT-SF FSI IT-SF FSI	aneous inedule de de do de do de do de do de do de do de	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15 20 25 30 35	8	ent Equi Desc COMP BIN KITC TV E COMP PERS COMP	pment rip UTER EQPT. HEN TC. UTER APP.	En Co Va 1 1 16 1 1 .5	ergy Encrusump Coolue Un WA	Miscell ergy nsump Sch its Coc IT-SF FSI IT-SF FSI IT-SF FSI IT-SF FSI IT-SF FSI IT-SF FSI	nedule de	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15 20 25 30 35 40	8 Misc Equipm Number 1 1 1 1 1 1	ent Equi Desc COMP DIN. KITC TV E COMP PERS COMP	pment rip UTER EQPT. HEN TC. UTER APP. UTER	En Co Va 1 1 16 1 1 1 .5	ergy Ennsump Coolue Un WA	Miscell ergy nsump Sch its Coc its Coc it-SF FSI	aneous inedule de de doffic do la company de de de doffic de	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15 20 25 30 35 40 45	8	ent Equi Desc COMP DIN. KITC TY E COMP PERS COMP	pment rip UTER EQPT. HEN TC. UTER APP. UTER APP. UTER	En- Co Va 1 1 1 16 1 1 1 .5 1	ergy Ennsump Coo Lue Un WA WA WA WA WA WA WA WA	Miscell ergy nsump Sch its Coc its FSI IT-SF FSI	aneous de	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15 20 25 30 35 40 45 50	Misc Equipmon Number 1 1 1 1 1 1 1 1 1	ent Equi Desc COMP DIN. KITC TV E COMP PERS COMP PERS	pment rip UTER EQPT. HEN TC. UTER APP. UTER APP. UTER	En Co Va 1 1 16 1 1 .5 1 .5	ergy Ennsump Coo Lue Un WA WA WA WA WA WA WA WA WA	Miscellergy nsump Schits Coo IT-SF FSI	aneous de	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15 20 25 30 35 40 45 50 55	Misc Equipmon Number 1 1 1 1 1 1 1 1 1 1	ent Equi Desc COMP DIN. KITC TV E COMP PERS COMP PERS COMP	pment rip UTER EQPT. HEN TC. UTER APP. UTER APP. UTER APP. UTER	Env Co Va 1 1 16 1 1 .5 1 .5	ergy Environment Collue Un WA	Miscellergy nsump Schits Coo IT-SF FSI	aneous inedule de de doffic do l'AKITCH de	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Card 2 Room Number 5 10 15 20 25 30 35 40 45 50 55	Misc Equipmon Number 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ent Equi Desc COMP DIN. KITC TV E COMP PERS COMP PERS COMP	pment rip UTER EQPT. HEN TC. UTER APP. UTER APP. UTER APP. UTER APP.	En Co Va 1 1 16 1 1 .5 1 .5	ergy Environment Colluction United Wales W	Miscellergy nsump Schits Coc IT-SF FSI	aneous nedule de HOFFIC HBARRL HOFFIC HBARRL HOFFIC HBARRL HOFFIC HBARRL HOFFIC HBARRL	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Room Number 5 10 15 20 25 30 35 40 45 50 55 60 65	8	ent Equi Desc COMP DIN. KITC TV E COMP PERS COMP PERS COMP PERS COMP	pment rip UTER EQPT. HEN TC. UTER APP. UTER APP. UTER APP. UTER APP. UTER	Env Cov Va 1 1 16 1 1 .5 1 .5 1	ergy Environment Collue Un WA	Miscellergy nsump Schits Coc IT-SF FSI	aneous dedule doffic	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Room Number 5 10 15 20 25 30 35 40 45 50 65 70	8	ent Equi Desc COMP DIN. KITC TV E COMP PERS COMP PERS COMP PERS COMP PERS	pment rip UTER EOPT. HEN TC. UTER APP. UTER APP. UTER APP. UTER APP. UTER	Env Cov Va 1 1 1 1 1 5 5 1 1 5 5 1 1 1 1	ergy Environment Colluction University WA	Miscellergy nsump Sch its Coc IT-SF FSI	aneous dedule doffic	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•
Room Number 5 10 15 20 25 30 35 40 45 50 55 60 65	8	ent Equi Desc COMP DIN. KITC TV E COMP PERS COMP PERS COMP PERS COMP PERS	pment rip UTER EOPT. HEN TC. UTER APP. UTER APP. UTER APP. UTER APP. UTER APP. UTER	Env Co Va 1 1 16 1 1 .5 1 .5 1	ergy Environment Collus Un WA	Miscellergy nsump Schits Coc IT-SF FSI	aneous dedule doffic doffic	Equipment Energy Meter	Perc of L	ent Per oad Mis	cent c. Load	Perd	c. Sens		•

Card 29----- Room Airflows -----

-----Infiltration-----

CFM

Room ----Cooling----- ----Heating-----

Units Value CFM 3975

Number Value Units

3975

--Reheat Minimum--Value Units

Card 29)	• • • • • • • • • • • • • • • • • • • •			Room Air	flows			• • • • • • • • • • • • • • • • • • • •	
	•••••	Venti	lation			Infil	tration			
Room	C00	ling	Hea	ting	Coo	ling	Неа	ting	Reheat	Minimum
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
10	20	CFM-P	20	CFM-P						
15	3000	CFM	3000	CFM						
20	17385	CFM	17385	CFM						
25	7700	CFM	7700	CFM						
30	12000	CFM	12000	CFM						
35	7700	CFM	7700	CFM						
40	12000	CFM	12000	CFM						
45	7700	CFM	7700	CFM						
50	12000	CFM	12000	CFM						
55	7700	CFM	7700	CFM						
60	12000	CFM	12000	CFM						
65	900	CFM	900	CFM						
70	20	CFM-P	20	CFM-P						
75	20	CFM-P	20	CFM-P						
80	12700	CFM	12700	CFM						
85	12200	CFM	12200	CFM						

Card 31			Part	ition Param	eters -				
Room	Partition	Partition	Partition	Partition	Const	Temp	Cooling	Heating	Adjacent
Number	Number	Length	Height	U-Value	Type	Flag	Temp	Тетр	Room No
5	1	264	12.5	.23	103	HRLYOADB			
5	2	264	12.5	.23	103	HRLYOADB			
5	3	680	12.5	.15	103	HRLYCADB			
10	1	220	12.5	.44	107	HRLYOADB			
25	1	244	13	.20	107	HRLYOADB			
30	1	244	13	.20	107	HRLYOADB			
35	1	244	13	.20	107	HRLYOADB			
40	1	244	13	.20	107	HRLYOADB			
45	1	244	13	.20	107	HRLYOADB			
50	1	244	13	.20	107	HRLYOADB			
55	1	244	13	.20	107	HRLYOADB			
60	1	244	13	.20	107	HRLYOADB			
80	1	30	12	.10	107	HRLYOADB			

Card 33-				•••• E	xternal Shac	ling			
		OVERHA	NG			VERTICAL F	INS		
		Height				Left		Right	Adjacent
Shading	Glass	Above	Projection	Glass	Projection	Projection	Projection	Projection	Building
Type	Height	Glass	Out	Width	Left	Out	Right	Out	Flag
3	5.5	1	2						
4	4	1	5						
5	4	1	3						

----- System Section Alternative #1 -----Card 39- System Alternative Number Description EXISTING SYSTEM Card 40----- System Type ----------OPTIONAL VENTILATION SYSTEM-----System Ventil Cooling Heating Cooling Heating Static Set System Deck Location SADBVh SADBVh Schedule Schedule Pressure Number Type VAV M7 Card 41----- Zone Assignment -----System Ref #6 Ref #5 Ref #4 Set Ref #1 Ref #2 Ref #3 Begin End Begin End Begin End Begin End Begin End Begin End Number 5 20 1 25 85 Card 42----- Fan SP and Duct Parameters-----System Cool Heat Return Mn Exh Aux Rm Exh Cool Return Supply Supply Return Set Fan Fan Fan Fan Fan Fan Htr Fan Mtr Duct Duct Air SP SP SP Loc Loc Ht Gn Loc Path Number SP SP SP 1 1.5 1.5 2 1.5 1.5 Card 45----- Equipment Schedules -----System Main Direct Indirect Auxiliary Main Auxiliary Main Evap Evap Heating Preheat Reheat Mech. Heating Set Cooling Cooling Humidity Coil Coil Coil Coil Coil Number Coil Economizer Coil FTSAMCLG FTSAMHTG FTSAMHTG FTSAMHTG 1 FTSAMHTG FTSAMHTG FTSAMHTG FTSAMCLG ----- Equipment Section Alternative #1 -----

```
---- Demand Limit ---
       Elec Consump Elec Demand Demand
                                                              Temperature
Alternative Time of Day Time of Day Limit
Number Schedule Schedule Max KW Alternative Description
                                                          Schedule Drift
                               BASE CASE
1
Card 60----- Cooling Load Assignment-----
Load All Coil Cooling
Asan Loads To Equipment -Group 1- -Group 2- -Group 3- -Group 4- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-
Ref Cool Ref Sizing Begin End Begin End
          BLKPLANT 1 1
1 1
          BLKPLANT 2
                      2
Card 62------ Cooling Equipment Parameters ------
          Num -----COOLING-----
                                      Cool Equip
         Of --Capacity-- ----Energy----
                                       --Capacity-- ----Energy----
Ref Code
                                                                 Num Type Number
                           Value Units
                                      Value Units
                                                    Value Units
Num Name
         Units Value Units
                          329
1 EQ1001S 1 438 TONS
                                 KW
2 EQ1001S 1
3 EQ1001S 1
                           517
                                 KW
                                                                      SED
              544
                   TONS
              442 TONS
                          517
                                                                      SER
                                 KW
Card 63----- Cooling Pumps and References -----
Cool --- CHILLED WATER---- ---- CONDENSER----- --- HT REC or AUX---- Switch-
Ref Full Load Full Load Full Load Full Load Full Load over Cold
                                                            Cooling Misc.
                         Units Value Units Control Storage Tower Access.
Num Value
          Units Value
                  22.38
  29.84
          KW
                          KW
1
                                                            2
                  29.84
2
   18.65
          KW
                         KV
                                                            2
                  29.84
                         KW
3
Card 65----- Heating Load Assignment
      All Coil
Load
               -Group 1- -Group 2- -Group 3- -Group 4- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-
Reference Heating Ref Begin End Begin End
        1
                     1
                 2
2
        3
                     2
Card 67----- Heating Equipment Parameters
                                                      Seq Switch
Heat Equip Number HW Pmp
                                          Energy
                                                                             Demand
                                                                              Limit
          Of
                  Full Ld
                               Cap'y
                                          Rate
                                                      Order over Hot Misc.
Ref
      Code
Number Name Units Value Units
                                          Value Units
                                                      Number Control Strg Acc. Cogen Number
                               Value Units
                               5317 MBH
                                          7500 MBH
                                                      1
1
      1350HWB1 1
                 29.84 KW
                               4336 MRH
                                          5800 MBH
                                                      2
      1350HWB2 1
2
                                               MBH ;
                               5912 MBH
                                          8369
                                                      1
      1300HWHB 1
                 11.19 KW
3
                                          8369 MBH
                                                     2
                               5912 MBH
      1300HWHB 1 11.19 KW
```

Card 59----- Equipment Description / TOD Schedules -----

ase	Base		Hourly						and					
tility	/ Utilit	;y	Demand	Demand		e Energy		ence Lim				ng		
umber	Descri	•	Value	Units	Code	Type	Numbe	r Num	ber T	emp	Temp			
		PUMP HT LOS	19.45	TONS		G CHILL-LE								
		IT LOSS	482.9	MBH		G HOT-LD	1							
		PUMP HT LOS	45.56	TONS		G CHILL-LE								
	PIPE 1	IT LOSS	1312.5	МВН	FTSAMHT	G HOT-LD	3							
4 7				Candanaa	- / Caali	na Touan D	- n-matar							
ard /	Cooling			Energy	Energy	ng rower r	ai ometer		Percent			ow Spd		
OUAT	Tower		Canacity	_ •		Fluid	Tower			Energy		nergy		
ef	Code	Value	Units	Value	Units	Type	Type		Low Spd			nits		
ет	E95100	Agroc	Units	14.92	KW	175~	1712	1	50	7.46	K1			
!	EQ5100			52.22	KW			2						
	5 #1				- Miscell 2	laneous Acc	essory ·		#3	•••••		•••••		
	Equip	Energy	Energy S			Energy	Energy	Sched	Equip	Energ	У	Energy	Sched	
	Code	Value					Units		Code	Value	. 1	Units	Code	
		11.19	KW				KW							
2	EQ5001	18.65	KW											
3	E95240	18.65 7.46	KW KW ipment Sec	tion Alte	ernative #	#2		••••						
	EQ5240	7.46	KW ipment Sec											
	Eq5240	7.46 Equ	KW ipment Sec	Equipmer	nt Descri							Limit -		
S Card 5	EQ5240	7.46	ipment Sec	Equipmer	nt Descrip						emand	Limit - emperatu		
3 Card 5	E05240	7.46 Equ	ipment Sec	Equipmer mand Demar Day Limit	nt Descrip nd : :W Alter	ption / TOC native Desc) Schedu	les			emand Te	Limit -		
Card 5	E05240	7.46 Equ :lec Consump	ipment Sec	Equipmer mand Demar Day Limit	nt Descrip nd : :W Alter	ption / TOC) Schedu	les		De	emand Te	Limit - emperatu		
Card 5 Altern Number 2	E05240	7.46 Equ Elec Consump Time of Day Schedule	ipment Sec Elec Den Time of Schedule	Equipmer mand Demar Day Limit e Max M	nt Descrip nd : CW Alter EXIST	ption / TOC native Desc) Schedu cription	les	BOILRS	Schedul	emand Te	Limit - emperatu Drift	ure	
Card 5 Altern Number 2 Card 6	E05240	7.46 Equ Elec Consump Time of Day Schedule	ipment Sec Elec Den Time of Schedule	Equipmer mand Demar Day Limit e Max M	nt Descrip nd : : CW Alter EXIST	ption / TOO native Desc ING CHILLED) Schedu eription RS, HIGH ssignmer	MODULAR	BOILRS	Schedul	emand Te le	Limit - emperatu Drift	ire	
Card 5 Altern Number 2 Card (Load Assign	E05240 59 native 1 f S	7.46 Equ Elec Consump Time of Day Schedule	ipment Sec Elec Den Time of Schedule	Equipmer mand Demar Day Limit • Max M	nt Descrip nd : CV Alter EXIST Heat	ption / TOO native Desc ING CHILLED ing Load A: 33Grou) Schedu eription RS, HIGH essignmer	MODULAR	BOILRS -Group 6	Schedul	emand Te le	Limit - emperatu Drift -Group	3Gr	oup 9
Card 5 Alterriumber 2 Card (Load Assign	E05240 59 native 1 S 65 All nment Loence Ho	7.46 Equivalent Consump (ime of Day Schedule) Il Coil oads To eating Ref	Elec Den Time of Schedule	Equipmer mand Demar Day Limit • Max M	nt Descrip nd : CV Alter EXIST Heat	ption / TOO native Desc ING CHILLED ing Load A: 33Grou) Schedu eription RS, HIGH essignmer	MODULAR	BOILRS -Group 6	Schedul	emand Te le	Limit - emperatu Drift -Group	3Gr	oup 9
Card 5 Alterriumber 2 Card (Load Assign	E05240 59 native 1 f S	7.46 Equivalent Consump (ime of Day Schedule) Il Coil oads To eating Ref	ipment Sec Elec Den Time of Schedule	Equipmer mand Demar Day Limit • Max M	nt Descrip nd : CV Alter EXIST Heat	ption / TOO native Desc ING CHILLED ing Load A: 33Grou) Schedu eription RS, HIGH essignmer	MODULAR	BOILRS -Group 6	Schedul	emand Te le	Limit - emperatu Drift -Group	3Gr	oup 9
Card 5 Alterriumber 2 Card (Load Assign	E05240 59 native 1 S 65 All nment Loence Ho	7.46 Equivalent Consump (ime of Day Schedule) Il Coil oads To eating Ref	Elec Den Time of Schedule	Equipmer mand Demar Day Limit • Max M	nt Descrip nd : CV Alter EXIST Heat	ption / TOO native Desc ING CHILLED ing Load A: 33Grou) Schedu eription RS, HIGH essignmer	MODULAR	BOILRS -Group 6	Schedul	emand Te le	Limit - emperatu Drift -Group	3Gr	oup 9
Gard 5 Number 2 Card (Lossing Refer	E05240 S9 Enative I C S Al Inment L ence H 1	7.46 Equiver the consumption of Day schedule the consumption	Elec Den Time of Schedule	- Equipmer mand Demar Day Limit Hax H - Hax H	nt Descrip id : GW Altern EXIST Heat Group d Begin	ption / TOO native Desc ING CHILLED ing Load A 3Grou End Begin) Schedu cription RS, HIGH ssignmer p 4C End Be	HODULAR It Group 5- Igin End	BOILRS -Group 6 Begin En	Schedul Group d Begin	emand Te le	Limit - emperatu Drift -Group Begin I	sGr	in En
Card 5 Altern Number Card (Assign	Eq5240 59 Equip 67 Equip	7.46 Equivalent Consump (ime of Day schedule) Il Coil coads To ceating Ref	Elec Den Time of Schedule	- Equipmer mand Demar Day Limit Hax H - Hax H	nt Descrip id : CM Altern EXIST Heat Group d Begin	ption / TOO native Desc ING CHILLE ing Load A 3Grou End Begin) Schedu cription ts, HiGH ssignmer p 40 End Ba	HODULAR It Group 5- Igin End	BOILRS -Group 6 Begin En	Schedul Group - Begin	emand Te Le	Limit - emperatu Drift -Group Begin	8Gr End Beg	in En
Card 5 Altern Number 2 Card (Assign Refer 1	Eq5240 S9 Enative 1 All nment Loence Ho	7.46 Equivalent Consumption of Day Schedule Ul Coil Coads To Coating Ref	Elec Den Time of Schedule	- Equipmer mand Demar Day Limit Hax H - Group 2 Begin En	nt Descrip id c W Alter EXIST Heat Group d Begin Heati	ption / TOO native Desc ING CHILLEI ing Load A 3Group End Begin ing Equipme E) Schedu cription rts, HIGH ssignmer p 46 End Be nt Param nergy ate	HODULAR iroup 5- igin End	-Group 6 Begin En	Schedul Groul d Begin Switch	emand Te le	Limit - emperatu Drift -Group Begin	8Gr End Beg	in En
Card 5 Altern Number 2 Card (Assign	Eq5240 S9	7.46 Equivalent Consumption of Day Schedule Ul Coil coads To coating Ref	Elec Den Time of Schedule	- Equipmer mand Demar Day Limit Hax H - Hax H	nt Descrip nd : CW Altern EXIST Heat Group d Begin Heati Cap'y Value L	ption / TOO native Desc ING CHILLED ing Load A 3Group End Begin ing Equipme E R Units V	o Schedu cription RS, HIGH ssignmer p 40 End Be nt Param nergy ate alue U	HODULAR It Group 5- Igin End	-Group 6 Begin En	Schedul Group - Begin	emand Te le	Limit - emperatu Drift -Group Begin	8Gr End Beg	in En

at	= t	No4	- UII D				Energy		Seq	Switch				Demai
	Equip		r HW Prop		Cont		Rate	'	Order	over	Hot	Misc		Limi
ef	Code	Of	Full Ld		Cap'y		Value	Units		Control				n Numb
	Name	Units		Units	1830	Units MBH	2000	MBH	2	Control	01.9	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2030	
	BOILHEFT		5.6	KW			2000	MBH	3					
	BOILHEFT		5.6	KW	1830		2000	MBH	4					
	BOILHEFT	1	5.6	KW	1830	MBK	2000	MON	•					
ard 7	1				Base Ut	ility Par	ameters -							
ase	Base		Hour		urly			Equip	Demand					
tilit	y Utility	,	Dema	nd De	mand Sci	hedule E	nergy	Reference	Limiting	Entering	Leav	ring		
umber	Descrip	•	Valu	e Un	its Co	de 1	ype	Number	Number	Temp	Temp)		
	PIPE HI	LOSS	1795	.4 MB	SH FT	SAMHTG H	IOT-LD	1						
••••		6	Equipment S	Section	Alternat	ive#3								
ard 5			ump Elect			scription	n / T00 Sc	hedules -						
lterr	ative Ti	me of Da	ay Time o	of Day I	Limit						T	empera	ature	
umber	Sc.	hedul e	Schedu	ale I	Max KW A	lternati	ve Descrip	otion		Sched	ule	Dri	ft	
5					W	ATER COO	LED CENTR.	CHILLER,	EXIST BOI	LR				
.oad Asgn	All Coil Loads To	Coolin Equipm	ent -Grou	p 1G	roup 2-	-Group 3	g Load As: Group	signment 4Grou	 1р 5Gro	up 6G	roup 7	'G	roup 8-	-Grou
.oad Isgn Ref	All Coil	Coolin Equipm	g ent -Grou Begin	p 1G	roup 2-	-Group 3	g Load As: Group	signment 4Grou		up 6G	roup 7	'G	roup 8-	-Groo Begii
oad sgn ef	All Coil Loads To Cool Ref 1	Coolin Equipm Sizing BLKPLA	g ent -Grou Begin NT 1	p 1G End Be 2	roup 2- gin End	-Group 3 Begin En	g Load As: Group d Begin	signment 4Grou End Begin	up 5Gro n End Begi	up 6G n End Be	roup 7 gin En	'G	roup 8- gin End	Begi
oad sgn ef	All Coil Loads To Cool Ref 1	Coolin Equipm Sizing BLKPLA	g ent -Grou Begin NT 1	p 1G End Be Z	roup 2- gin End	-Group 3 Begin En Ling Equi	g Load As:Group d Begin	signment 4Grot End Begir ametersHEAT RE	up 5Gra n End Begi	nup 6 G n End Be	roup 7 gin En	'G nd Be	roup 8- gin End	Begia
oad sgn ef	All Coil Loads To Cool Ref 1 62 Equip Code	Coolin Equipm Sizing BLKPLA Num Of	g went -Grou Begin NT 1	p 1G End Be 2	roup 2- gin End Cool GEner	-Group 3 Begin En ling Equi	g Load As:Group d Begin	signment 4Grot End Begir ametersHEAT Ri	up 5Gro n End Begi ecovery	up 6 - G n End Be	roup 7 gin En Sec Orc	'G nd Be nd Be	roup 8- gin End De	Begin
oad sgn ef Card Cool Ref	All Coil Loads To Cool Ref 1 62 Equip Code Name	Coolin Equipm Sizing BLKPLA Num Of Units	g went -Grou Begin NT 1 Capacity Value Uni	p 1G End Be Z COOLIN	roup 2- gin End Cool GEner Value	-Group 3 Begin En ling Equi gy Units	g Load As:Group d Begin	signment 4Grot End Begir ametersHEAT RE	up 5Gra n End Begi	nup 6 G n End Be	roup 7 gin En Sec Orc Num	'G nd Be der S n T	roup 8- gin End Deckeq Li	Begin
oad sgn ef card cool tef	All Coil Loads To Cool Ref 1 62 Equip Code Name YCENT134	Coolin Equipm Sizing BLKPLA Num Of Units	g Hent -Grou Begin NT 1 Capacity Value Uni 425 TON	p 1G End Be 2 COOLIN	roup 2- gin End Cool G Value 264	-Group 3 Begin En ling Equi gy Units KW	g Load As:Group d Begin	signment 4Grot End Begir ametersHEAT Ri	up 5Gro n End Begi ecovery	up 6 - G n End Be	roup 7 gin En Sec Orc Num 1	'G nd Be	roup 8- gin End De seq Li ype Nu	Begin
oad sgn ef card cool tef	All Coil Loads To Cool Ref 1 62 Equip Code Name	Coolin Equipm Sizing BLKPLA Num Of Units	g went -Grou Begin NT 1 Capacity Value Uni	p 1G End Be 2 COOLIN	roup 2- gin End Cool GEner Value	-Group 3 Begin En ling Equi gy Units	g Load As:Group d Begin	signment 4Grot End Begir ametersHEAT Ri	up 5Gro n End Begi ecovery	up 6 - G n End Be	roup 7 gin En Sec Orc Num	'G nd Be	roup 8- gin End Deckeq Li	Begin
oad sgn ef dard cool tef ium	All Coil Loads To Cool Ref 1 62 Equip Code VCENT134 YCENT134	Coolin Equipm Sizing BLKPLA Num Of Units 1	g Hent -Group Begin NT 1 Capacity Value Uni 425 TON 840 TON	p 1G End Be 2 COOLIN	roup 2-gin End Cool G Value 264 487	-Group 3 Begin En Ling Equi gy Units KW	g Load As:Group d Begin Capa Value	4Grot 4Grot End Begir ameters HEAT Ri city Units	up 5Gra n End Begi ECOVERY ECOVERY Value	up 6G n End Be gy Units	roup 7 gin En Sec Orc Num 1 2	'G nd Be der S n T P	roup 8- gin End De seq Li ype Nu	Begin
coad asgn def Card Cool Ref alum 1	All Coil Loads To Cool Ref 1 62 Equip Code Name YCENT134	Coolin Equipm Sizing BLKPLA Num Of Units 1	g ent -Grou Begin NT 1 Capacity Value Uni 425 TON 840 TON	p 1G End Be 2 COOLIN	roup 2- gin End Cool GEner; Value 264 487	-Group 3 Begin En Ling Equi	g Load As: Group d Begin I pment ParCapa Value	4Grot 4Grot End Begin ameters HEAT RI city Units	up 5Gra n End Begi ECOVERY ECOVERY Value	up 6G n End Be	roup 7 gin En Sec Orc Num 1 2	'G nd Be der S n T P	roup 8- gin End De seq Li ype Nu	Begin
coad lasgn Ref l Cord Ref Num 1 2	All Coil Loads To Cool Ref 1 62 Equip Code Name YCENT134 63	Coolin Equipm Sizing BLKPLA Num Of Units 1	g ent -Grou Begin NT 1 Capacity Value Uni 425 TON 840 TON	p 1G End Be 2COOLIN	roup 2- gin End Cool G Value 264 487	-Group 3 Begin En Ling Equi gy Units KW KW mps and F	g Load As:Group d Begin	signment 4Grou End Begin ametersHEAT Ri city Units	up 5Gro n End Begi ECOVERY ECOVERY Value	up 6G n End Be	Secondaria	'G kd Be der S P P	roup 8- gin End De seq Li ype Nu	Begin
Card Cool Ref	All Coil Loads To Cool Ref 1 62 Equip Code Name YCENT134 63CHILLEI Full Load	Coolin Equipm Sizing BLKPLA Num Of Units 1	g ent -Grou Begin NT 1 Capacity Value Uni 425 TON 840 TON	p 1G End Be 2COOLIN ts S S	roup 2- gin End Cool G Value 264 487 cooling Pu R ull Load	-Group 3 Begin En Ling Equi gy Units KW KW mps and F	g Load As:Group d Begin	4Grou End Begin ametersHEAT Ri City Units	up 5Gro n End Begi ECOVERY Ener Value	up 6 - G n End Be	Second 1	'G kd Be der S P P	roup 8- gin End De seq Li ype Nu	Begir mend mit
Load Asgn Ref 1 Cool Ref Num 1 2 Card Cool	All Coil Loads To Cool Ref 1 62 Equip Code Name YCENT134 63	Coolin Equipm Sizing BLKPLA Num Of Units 1	g ent -Grou Begin NT 1 Capacity Value Uni 425 TON 840 TON	p 1G End Be 2COOLIN ts S S COMDENSE Load Ft	roup 2- gin End Cool G Value 264 487 cooling Pu R ull Load	-Group 3 Begin En ling Equi gy Units KW KW mps and FHT Ri Full Los	g Load As:Group d Begin Capa Value Capa Value	4Grou End Begin ametersHEAT Ri City Units	up 5Gro n End Begi ECOVERY ECOVERY Value	up 6 - G n End Be	Second 1	'G Be	roup 8- gin End De seq Li ype Nu	Begi mend mit

```
Card 63----- Cooling Pumps and References
Cool --- CHILLED WATER---- ---- CONDENSER----- --- HT REC or AUX---- Switch-
Ref Full Load Full Load Full Load Full Load Full Load Full Load over Cold Cooling Misc.
                                                            Units Value Units Control Storage Tower Access.
Num Value Units Value
                                                                                                                1
                                         55.95
                                                            KI
2 55.95
                        KW
Card 71------ Base Utility Parameters -----
Base Base Hourty Hourly
Utility Utility Demand Demand Schedule Energy
Wumber Descrip Value Units Code Type
                                                                                                         Equip Demand
                                                                                                         Reference Limiting Entering Leaving
                                                                                                         Number Number Temp Temp
              PIPE-PUMP HT LOS 22
                                                           TONS FTSAMCLG CHILL-LD 1
1
              PIPE-PUMP HT LOS 43
                                                          TONS FTSAMCLG CHILL-LD 2
Card 72-- Switchover Controls ------
                                        Outside
 Control Load Load Air
                                                      Sched
 Reference Value Units DB
                                                      Code
           425 TONS
 Card 74------ Condenser / Cooling Tower Parameters -----
                                                           Energy Energy Number Percent Low Spd Low Spd
       Cooling
                                                                           Consump Fluid Tower Of Airflow Energy Energy
                           Capacity Capacity Consump
                           Value Units
                                                           Value
                                                                           Units Type Type Cells Low Spd Value
 Ref Code
                                                                                                                                                                KV
            EQ5100
                                                           14.92
                                                                           KW
                                                                                                                      1
                                                                                                                                  50 7.46
                                                                           KV
                                                                                                                      2
 2
           F05100
                                                           52.2
 ----- Equipment Section Alternative #4 ------
  Card 59----- Equipment Description / TOD Schedules -----
                                                                                                                                               ---- Demand Limit ---
                     Elec Consump Elec Demand Demand
                                                                                                                                                    Temperature
  Alternative Time of Day Time of Day Limit
                     Schedule Schedule Max KW Alternative Description
  Number
                                                                             WAT. COOLED DUAL SCREW CHILR, EXIST BLR
  4
  Card 60------ Cooling Load Assignment-----
  Load All Coil Cooling
  Asgn Loads To Equipment -Group 1- -Group 2- -Group 3- -Group 4- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-
  Ref Cool Ref Sizing Begin End Begin
```

ef Cod		JR	C(OOLING			HEAT REC	OVERY		Seq		Deman
	e 01	C	apacity	Ene	ergy	Capa	city	Energy	/	Order	Seq	Limit
	e Ur	its Val	ue Units	Value	Units	Value	Units	Value I	Jnits	Num	Type	Numbe
YSC	RW22 1	425	TONS	272	KW					1	PAR	
YSC	RW22 1	840	TONS	538	KW					2	PAR	
				Cooling (
				DENSER								
tef Ful				d Full Load				Cold	Cooling			
ium Val		Jnits	Value	Units	Value	Units		l Storage		Access	•	
29.	84 1	CW	29.84	KW			1		1			
2 55.	.95	KW	55.95	KM			1		2			
Card 71- Base	Base	•••••	Hourly	Base Hourly		arameters	Equip	Demand				
Base				Hourty			Equip		Entering	Leavir	. . ng	
Base Utility	Base		Hourly Demand	Hourly Demand	Schedule		Equip Reference	Demand	Entering Temp	Leavir Temp	ng	
Base Utility	Base Utility Descrip		Hourly Demand Value	Hourly Demand	Schedule Code	Energy	Equip Reference Number	Demand Limiting	-		ng	

Card 7	4			Condenser	/ Cooling] Tower	Parameters				
	Cooling			Energy	Energy			Number	Percent	Low Spd	Low Spd
Tower	Tower	Capacity	Capacity	Consump	Consump	Fluid	Tower	Of	Airflow	Energy	Energy
Ref	Code	Value	Units	Value	Units	Type	Type	Cells	Low Spd	Value	Units
1	EQ5100			14.92	KW			1	50	7.46	KW
2	E05100			52.22	KV			2			

Utility Description Reference Table

```
Schedules:
    FSHBARRL F.S.H. BARRACKS LIGHT/MISC. SCHEDULE
    FSHBARRP F.S.H. BARRACKS PEOPLE SCHEDULE
    FSHDINL F.S.H. DINING LIGHTING/MISC. LOAD SCHED.
    FSHDINP F.S.H. DINING PEOPLE SCHEDULE
    FSHKITCH F.S.H. KITCHEN INTERNAL LOAD SCHEDULE
     FSHOFFIC F.S.H. OFFICE INTERNAL LOAD SCHEDULE
    FTSAMCLG EEAP BOILER/CHILLER STUDY
    FTSAMHTG EEAP BOILER/CHILLER STUDY
System:
    MZ MULTIZONE
     VAV VARIABLE AIR VOLUME
Equipment:
     Cooling:
          EQ1001S 2-STG CENTRIFUGAL CHILLER <550 TONS
          YCENT134 YORK CENT. R-134A CHILL
          YSCRW22 YORK W.C. SCREW CHILL.
     Heating:
          1300HWHB EXISTING FORCE DRAFT C.B. HWH BOILER
          1350HWB1 EXISTING NAT. DRAFT RITE HWH BOILER
          1350HWB2 EXISTING NAT. DRAFT AJAX HWH BOILER
          BOILHEFT HIGH EFFICIENCY MODULAR FIRETUBE BOIL.
          Tower:
              EQ5100 COOLING TOWER FANS
        Misc:
           EQ5001 CHILLED WATER PUMP - CONSTANT VOLUME
           EQ5020 HEATING WATER CIRCULATION PUMP
```

EQ5240 BOILER FORCED DRAFT FAN

```
Card 59----- Equipment Description / TOD Schedules -----
        Elec Consump Elec Demand Demand
                                                         ---- Demand Limit ---
 Alternative Time of Day Time of Day Limit
 Number Schedule Schedule Max KW Alternative Description Schedule Drift
                                                               Temperature
                               BASE CASE
Card 60----- Cooling Load Assignment-----
Load All Coil Cooling
Asgn Loads To Equipment -Group 1- -Group 2- -Group 3- -Group 4- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-
Ref Cool Ref Sizing Begin End Begin End
           BLKPLANT 1 1
          BLKPLANT 2
2
    2
Card 62----- Cooling Equipment Parameters
          Cool Equip
Ref Code
Num Name
         Units Value Units
                          Value Units
                                     Value Units Value Units
                                                              Num Type Number
1 EQ1001S 1 438 TONS
                         329
                               KW
2 EQ1001S 1
3 EQ1001S 1
            544 TONS
                         517
                               KU
                                                                   SER
             442 TONS 517
                               KU
                                                              2
                                                                   SER
Card 63----- Cooling Pumps and References -----
Cool ---CHILLED WATER---- ----CONDENSER----- ---HT REC or AUX---- Switch-
Ref Full Load Full Load Full Load Full Load Full Load over Cold Cooling Misc.
Num Value Units Value Units Value Units Control Storage Tower Access.
1 29.84
          KW
                 22.38
                        KW
                                                        1
        KW
2
   18.65
                 29.84
                        KW
                                                        2
                                                              2
3
                 29.84
                        หม
                                                        2
Card 65----- Heating Load Assignment -----
Assignment Loads To Group 1- -Group 2- -Group 3- -Group 4- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-
Reference Heating Ref Begin End Begin End
       1 1 1
       3
               2
Card 67----- Heating Equipment Parameters -----
Heat Equip Number HW Pmp
                                       Energy Seq Switch
                                                                          Demand
     Code
         Of Full Ld
                            Cap'y
                                       Rate
                                                  Order over Hot Misc.
Number Name Units Value Units
                            Value Units
                                       Value Units
                                                  Number Control Strg Acc. Cogen Number
1
    1350HWB1 1
                29.84 KW
                            5317 MBH
                                       7500 MBH
                                                  1
     1350HWB2 1
2
                            4336 MBH
                                       5800 MBH
                                                  2
    1300HWHB 1
3
                11.19 KW
                            5912 MBH
                                       8369
                                                  1
     1300HWHB 1
                11.19 KW
                            5912 MBH
                                       8369
                                           MBH
                                                  2
                                                                 3
```

Equip Referen Number 1 1 2 3 rameters Tower Type sssory	Democe Lim Num Number Of Cells 1	nand miting En mber Te Percent Airflow Low Spd 50	Low Spd Energy	Low Spd Energy Units	
Number 1 1 2 3 rameters Tower Type ssory nergy Scinits Cody	Number Of Cells 1 2	Percent Airflow Low Spd 50 #3 Equip	Low Spd Energy Value 7.46	Low Spd Energy Units KW	
1 1 2 3 rameters Tower Type sssory nergy Scinits Cody	Number Of Cells 1 2	Percent Airflow Low Spd 50	Low Spd Energy Value 7.46	Low Spd Energy Units KW	
1 2 3 3 Frameters Tower Type Sssory	Number Of Cells 1 2	Percent Airflow Low Spd 50 #3 Equip	Low Spd Energy Value 7.46	Low Spd Energy Units KW	
2 3 rameters Tower Type sssory nergy Scinits Cody	Number Of Cells 1 2	Percent Airflow Low Spd 50 #3 Equip	Low Spd Energy Value 7.46	Low Spd Energy Units KW	
Tower Type ssory	Number Of Cells 1 2	Percent Airflow Low Spd 50 #3 Equip	Low Spd Energy Value 7.46	Low Spd Energy Units KW	
Tower Type ssory nergy Sci	Number Of Cells 1 2	Percent Airflow Low Spd 50 #3 Equip	Low Spd Energy Value 7.46	Low Spd Energy Units KW	
Tower Type ssory nergy Sci	Number Of Cells 1 2	Percent Airflow Low Spd 50 #3 Equip	Low Spd Energy Value 7.46	Low Spd Energy Units KW	
Tower Type ssory nergy Scinits Cod	Of Cells 1 2	Airflow Low Spd 50 #3 Equip	Energy Value 7.46	Energy Units KW	
ssory nergy Scinits Cody	Cells 1 2	Low Spd 50 #3 Equip	Value 7.46	Units KW	
ssory nergy Sci nits Cod	1 2	50 #3 Equip	7.46	KW	
ssory nergy Sci nits Co	2 :hed	#3 Equip	•••••		
nergy Sci nits Co W	hed	#3 Equip		••••••	
nits Co		Equip	Energy		
nits Co			Energy	_	
W	ALC.	code	Value		
			Value	Units	Code
•••••					
•••••					
Schedules			···· Deman		
iption			Schedule	Drift	
NGINE CHLI	R, EXIS	ST BOILR			
ssignment				•••••	•••••
	oup 5-	-Group 6	Group	7Groux	p 8Gr
p 4Gre		Begin En	d Begin E	nd Begin	End Beg
p 4Gre End Beg	in End			_	
NG SS	INE CHL ignment 4Gr	INE CHLR, EXIS	tion INE CHLR, EXIST BOILR Ignment	tion Schedule INE CHLR, EXIST BOILR ignment 6Group 5Group 6Group	

A - 4	Equip			C	OOLING	•••••		HEA	T RECOV	ERY		Seq		D
	Code	Of		acity	E	nergy		oacity		Energ		Order	Seq	ì
	Name			Units	Value	Units	Value	. Units			Units	Num	Туре	
	YENGORIV	1	840	TONS	5208	MBH						2	PAR	
ard	63	•••••	•••••		Coolina	Pumos an	d Reference							
•••	CHICLE	D MAISK		CONI	JENSER	HT	REC or AUX	C	uitch-		••••••			
er	Full Load	Full	Load	Full Load	full Lo	ad Full	Load Full	Load ov	ver	Cold	Cooling	Mina		
um	Value	Units		Value	Units	Value				Storage		Access.		
	29.84	KW		29.84	KW			1		o con age	1	Access.		
	55.95	KW		55.95	KW			1			2			
		٠												
ard ase	71 Base				Base	Utility	Parameters					•••••		
	ty Utilii	tv		Hourly	Hourly			Equip	_	emand				
umbe				Demand Value			Energy			imiting	Entering	Leaving		
		PUMP HT	LOS	22	Units TONS	Code	Туре	Number	· Nu	umber	Temp	Temp		
		PUMP HT		43	TONS		CHILL-LD							
				43	IONS	FISAMCLO	CHILL-LD	2						
ontro		l Load	Out I Air	side	hed									
ontro		l Load	Out I Air s DB	side	hed									
efer	ol Load ence Valu 425	f Load He Unit TONS	Out I Air s DB	tside Sc Co	hed de	/ Coolin								
ontro	ol Load ence Valu 425	f Load He Unit TONS	Out I Air s DB	tside Sc Co	hed de Condenser	/ Coolin	g Tower Pai	ameters						
ontro efero ard 7	ol Load	f Load We Unit TONS	Out I Air is DB	tside Sc	hed de Condenser Energy	Energy			Number	Percen	t Low Spd	Low S	pd	
ontro efero and 7 ower	ol Load ence Valu 425	f Load We Unit TONS	Out Air s DB	tside Sc Co	hed de Condenser Energy	Energy Consump	Fluid	Tower	Number Of	Percen Airflo	t Low Spd w Energy	Low 9	ipd Iy	
ontro efero and 7 wer ef	ol Load ence Valu 425 74 Cooling Tower	i Load	Out Air s DB	side Sc Co	hed de Condenser Energy Consump	Energy			Number Of Cells	Percen Airflo Low Sp	t Low Spd w Energy d Value	Low 9 Energ Units	ipd Iy	
entro efero erd 7	ol Load ence Valu 425 74 Cooling Tower Code	i Load	Out Air s DB	side Sc Co	hed de Condenser Energy Consump Value	Energy Consump Units	Fluid	Tower	Number Of Cells 1	Percen Airflo	t Low Spd w Energy	Low 9	ipd Iy	
ontro efero ard 7 ower ef	Cooling Tower Code E95100	i Load	Out Air s DB	side Sc Co	Condenser Energy Consump Value 14.92	Energy Consump Units KW	Fluid	Tower	Number Of Cells	Percen Airflo Low Sp	t Low Spd w Energy d Value	Low 9 Energ Units	ipd Iy	
ontro efero and 7 ower ef	Cooling Tower Code Eq5100	d Load be Unit TONS Capac	Out I Air is DB	side Sc Co 	Condenser Energy Consump Value 14.92 52.2	Energy Consump Units KW KW	Fluid Type	Tower Type	Number Of Cells 1 2	Percen Airflo Low Sp	t Low Spd w Energy d Value	Low 9 Energ Units	ipd Iy	
ontro efero end 7	Cooling Tower Code Eq5100	d Load be Unit TONS Capac	Out I Air is DB	side Sc Co 	Condenser Energy Consump Value 14.92 52.2	Energy Consump Units KW KW	Fluid	Tower Type	Number Of Cells 1 2	Percen Airflo Low Sp	t Low Spd w Energy d Value	Low 9 Energ Units	ipd Iy	
ontro efero and 7 ower ef	Cooling Tower Code Eq5100	d Load be Unit TONS Capac	Out I Air is DB	side Sc Co 	Condenser Energy Consump Value 14.92 52.2	Energy Consump Units KW KW	Fluid Type	Tower Type	Number Of Cells 1 2	Percen Airflo Low Sp	t Low Spd w Energy d Value	Low 9 Energ Units	ipd Iy	
ontro efero end 7	Cooling Tower Code Eq5100	d Load be Unit TONS Capac	Out I Air is DB	side Sc Co 	Condenser Energy Consump Value 14.92 52.2	Energy Consump Units KW KW	Fluid Type	Tower Type	Number Of Cells 1 2	Percen Airflo Low Sp	t Low Spd w Energy d Value	Low 9 Energ Units	ipd Iy	
ontro efero and 7 ower ef	Ol Load Property Value 425 74 Cooling Tower Code Eq5100 Eq5100	d Loace Unit TONS Capac Value	Out I Air IS DB It Ity C U Equipm	side Sc Co Co sapacity nits	Condenser Energy Consump Value 14.92 52.2	Energy Consump Units KW KW	Fluid Type	Томег	Number Of Cells 1 2	Percen Airflo Low Sp 50	t Low Spd w Energy d Value 7.46	Energ Units KW	Spd 3y ;	
ontro	Cooling Tower Code Eq5100	f Load We Unit TOWS	Out Air S DB iii ii U EEEquipm	side Sc Co Co Sapacity Inits	Condenser Energy Consump Value 14.92 52.2 ion Altern	Energy Consump Units KW KW	Fluid Type	Томег	Number Of Cells 1 2	Percen Airflo Low Sp 50	t Low Spd w Energy d Value 7.46	Energ Units KW	Spd 3y ;	
ontro efero and 7 ower ef	Cooling Tower Code Eq5100 Eq5100	Capac Value	Out I Air S DB ity C U	side Sc Co Co Capacity Inits	Condenser Energy Consump Value 14.92 52.2 ion Altern Equipment and Demand	Energy Consump Units KW KW	Fluid Type	Томег	Number Of Cells 1 2	Percen Airflo Low Sp 50	t Low Spd w Energy d Value 7.46	Low S Energ Units KW	Spd sy	
ontro efero and 7 ower ef	Cooling Tower Code Eq5100 Eq5100	Capac Value	Out I Air S DB ity C U Equipm	ent Section	Condenser Energy Consump Value 14.92 52.2 ion Altern Equipment and Demand	Energy Consump Units KW KW mative #3	Fluid Type	Tower Type	Number Of Cells 1 2	Percen Airflo Low Sp 50	t Low Spd w Energy d Value 7.46	Low S Energ Units KW	Spd sy t	
ontro efero and 7 ower ef	Cooling Tower Code Eq5100 Eq5100	Capac Value	Out I Air S DB ity C U Equipm	side Sc Co Co Capacity Inits	Condenser Energy Consump Value 14.92 52.2 ion Altern Equipment and Demand	Energy Consump Units KW KW Descript Alternal	Fluid Type	Tower Type chedules	Number Of Cells 1 2	Percen Airflo Low Sp 50	t Low Spd w Energy d Value 7.46	Low S Energ Units KW and Limi	Spd By S S t	

	All Coil			-Coorn 1						. 4			
nagii Ref	Cool Ref	Sinis	xiien (Paris For	-Group 2	- Group 3	Group 4-	-Group 5	Group	6Gr	oup 7-	-Group	8Group
1	1	BLKPL	-	1 2	i begin End	a Begin En	a Begin Enc	I Begin Er	d Begin E	nd Begi	in End	Begin	End Begin E
Cand	42												
Cool	Equip	Num			Co OLING	ooling Equi	pment Parame					•••••	•••••
	Code	Of		pacity		ergy	Capacit		ERY		Seq		Demand
Num	Name	Units		e Units	Value	Units	Value Un	•	Energy alue Uni		Order		Limit
1	YCENVFD	1	425	TONS	264	KW	Value on	its v	alue Uni	Its	Num 1	• •	Number
2	YCENVFD	1	840	TONS	487	KW					2	PAR PAR	
ard	63				- Cooling P	umps and R	eferences		•				
:00 l	CHILLED) WATER		COND	ENSER	HT RE	C or AUX	Switch-					
ter	Value	Full	Load				d Full Load	over	Cold (Cooling	Misc.		
ium	Value 29.84	Units KW	•	Value	Units	Value	Units	Control	Storage T	ower	Access		
2	55.95			29.84	KW			1	1	l .			
•	22.42	KW		55.95	KW			1	2	2			
ard	71			•••••	Base	Utility Par	rameters	•••••			•••••		
Base Itili	71Base	:y		Hourly Demand	Hourly Demand	Schedule E	nergy Re	uip D	emand imiting En		Leavin		
Base Utili iumbe	71 Base ty Utilit	y P		Hourly Demand Value	Hourly Demand Units	Schedule E	Eq Energy Re Type Nu	uip D ference L	emand imiting En		Leavinç Temp		
Base Utili Lumbe	71Base ty Utiliter Descri	y P UMP HT	LOS	Hourly Demand Value 22	Hourly Demand Units TONS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip D ference L	emand imiting En	itering			
Base Utili Lumbe	71Base ty Utiliter Descri	y P	LOS	Hourly Demand Value	Hourly Demand Units TONS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu	uip D ference L	emand imiting En	itering			
Base Utili Dumbe	71 Base ty Utilit P Descri PIPE-P	Y P PUMP HT	LOS	Hourly Demand Value 22 43	Hourly Demand Units TONS TONS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip D ference L	emand imiting En	itering			
Base Utili Numbe	71 Base ty Utilit P Descri PIPE-P	Y P PUMP HT	LOS LOS	Hourly Demand Value 22	Hourly Demand Units TONS TONS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip D ference L	emand imiting En	itering			
Base Utili Numbe I Card	71Base ty Utilit r Descri PIPE-P PIPE-P	P P PUMP HT PUMP HT Phover (LOS LOS Contro	Hourly Demand Value 22 43 pls utside ir Sci	Hourly Demand Units TONS TONS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip D ference L	emand imiting En	itering			
Base Utili Dumbe	71Base ty Utilit r Descri PIPE-P PIPE-P 72 Switc ol Load	P P PUMP HT Chover (LOS LOS Contro Od Aid	Hourly Demand Value 22 43 pls utside ir Sci	Hourly Demand Units TOWS TOWS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip D ference L	emand imiting En	itering			
lase Itili Iumbe	71Base ty Utilit r Descri PIPE-P PIPE-P	P P PUMP HT PUMP HT Phover (LOS LOS Contro Od Aid	Hourly Demand Value 22 43 pls utside ir Sci	Hourly Demand Units TOWS TOWS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip D ference L	emand imiting En	itering			
Base Utili Lumbe B Bard Contr	71Base ty Utilit r Descri PIPE-P PIPE-P 72 Switc ol Load	P P PUMP HT Chover (LOS LOS Contro Od Aid	Hourly Demand Value 22 43 pls utside ir Sci	Hourly Demand Units TOWS TOWS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip D ference L	emand imiting En	itering		-	
Base Utili Dumbe	71Base ty Utilit r Descri PIPE-P PIPE-P 72 Switc ol Load	P P PUMP HT Chover (LOS LOS Contro Od Aid	Hourly Demand Value 22 43 pls utside ir Sci	Hourly Demand Units TOWS TOWS	Schedule E Code 1 FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip D ference L	emand imiting En	itering			
Base Utili Umbe	71 Base ty Utilit r Descri PIPE-P PIPE-P 72 Switc ol Load dence Valu 425	P PUMP HT UMP HT Chover (Load E Unit	LOS LOS Contro Od Ai ts DE	Hourly Demand Value 22 43 bls utside ir Sch	Hourly Demand Units TONS TONS	Schedule E Code 1 FTSAHCLG (Eq Energy Re Type Nu CHILL-LD 1 CHILL-LD 2	uip D ference L mber N	emand imiting En .mber Te	atering emp			
dase Utili Lumbe	71 Base ty Utilit r Descri PIPE-P PIPE-P 72 Switc ol Load dence Valu 425	P PUMP HT UMP HT Chover (Load E Unit	LOS LOS Contro Od Ai ts DE	Hourly Demand Value 22 43 bls utside ir Sch	Hourly Demand Units TONS TONS TONS Condenser	Schedule E Code 1 FTSAMCLG (FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1	uip Di ference L mber Ni	emand imiting En umber Te	atering	Тепр		
dase Itili Iumbe Itumbe	71 Base ty Utilit r Descri PIPE-P PIPE-P 72 Switc ol Load ence Valu 425	P P PUMP HT Chover (Loade Uni TON:	LOS LOS Contro Oc d Aits DE	Hourly Demand Value 22 43 pols utside ir Sci 3 Coo	Hourly Demand Units TONS TONS Condenser Energy	Schedule E Code 1 FTSAMCLG (FTSAMCLG (Eq Energy Re Type Nu CHILL-LD 1 CHILL-LD 2	uip Di ference L mber Ni ters	emand imiting En umber Te	atering emp	Temp	Spd .	
dase Itili Iumbe Itumbe	71 Base ty Utilit PIPE-P PIPE-P 72 Swite ol Load ence Valu 425	P P PUMP HT Chover (Loade Uni TON:	LOS LOS Contro Ox d Ai tts DE	Hourly Demand Value 22 43 bls utside ir Sch	Hourly Demand Units TONS TONS Condenser Energy Consump	Schedule E Code 1 FTSAMCLG (FTSAMCLG (/ Cooling T Energy Consump Fi	Eq Energy Re Type Nu CHILL-LD 1 CHILL-LD 2	ters Number Of	emand imiting En umber Te Percent Airflow	LOW Sp Energy	Temp	Spd '9y	
dase Itili Itumbe Itumb	71 Base ty Utilit PIPE-P PIPE-P 72 Switc ol Load ence Valu 425	P P P P P P P P P P P P P P P P P P P	LOS LOS Contro Ox d Ai tts DE	Hourly Demand Value 22 43 bls utside ir Sc! 3 Coc	Hourly Demand Units TONS TONS Condenser Energy Consump Value	Schedule E Code 1 FTSAMCLG (FTSAMCLG (/ Cooling T Energy Consump Fi	Eq Energy Re Type Nu CHILL-LD 1 CHILL-LD 2	ters Number Of	emand imiting En umber Te Percent Airflow	LOW Sp Energy	Temp	Spd '9y	

03018504 BOILER-CHILLER STUDY
FT. SAM HOUSTON - SAN ANTONIO, TX.
CORPS OF ENGINEERS - FT. WORTH, TEXAS
HUITT - ZOLLARS INC.
AREA 1300

Weather File Code:

 Location:
 SAN ANTONIO, TEXAS

 Latitude:
 29.0 (deg)

 Longitude:
 98.0 (deg)

 Time Zone:
 6

 Elevation:
 792 (ft)

 Barometric Pressure:
 29.0 (in. Hg)

Summer Clearness Number: 0.90
Winter Clearness Number: 0.90
Summer Design Dry Bulb: 97 (F)
Summer Design Wet Bulb: 76 (F)
Winter Design Dry Bulb: 30 (F)
Summer Ground Relectance: 0.20
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)
Air Specific Heat: 0.2444 (Btu/lbm/F)
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: June To November
System Simulation Period: January To December
Cooling Load Methodology: TETD/Time Averaging

Time/Date Program was Run: 20: 5:15

Time/Date Program was Run: 20: 5:15 6/ 8/95 Dataset Name: FSH1300 .TM SYSTEM TOTALS LOAD PROFILE - ALTERNATIVE 1 EXISTING SYSTEM

System Totals

Percent	Cool	ing Loa	d	··· Heati	• • • • • •	
Design	Cap.	Hours	Hours	Capacity	Hours	Hours
Load	(Ton)	(%)		(Btuh)	(%)	
0 - 5	69.8	4	160	-534,786	18	516
5 - 10	139.5	5	206	-1,069,572	20	576
10 - 15	209.3	5	198	-1,604,358	9	270
15 - 20	279.1	8	316	-2,139,144	9	247
20 - 25	348.8	9	362	-2,673,930	10	274
25 - 30	418.6	6	269	-3,208,716	6	173
30 - 35	488.4	9	396	-3,743,502	10	295
35 - 40	558.2	6	263	-4,278,288	14	398
40 - 45	627.9	6	234	-4,813,074	4	109
45 - 50	697.7	6	265	-5,347,860	0	0
50 - 55	767.5	5	226	-5,882,647	0	0
55 - 60	837.2	8	321	-6,417,432	0	G
60 - 65	907.0	7	296	-6,952,219	0	0
65 - 70	976.8	8	336	-7,487,004	0	0
70 - 75	1,046.5	5	202	-8,021,791	0	0
75 - 80	1,116.3	3	126	-8,556,577	0	0
80 - 85	1,186.1	1	23	-9,091,363	0	0
85 - 90	1,255.9	0	0	-9,626,149	0	0
90 - 95	1,325.6	0	0	-10,160,935	0	0
95 - 100	1,395.4	0	0	-10,695,720	0	0
Hours Off	0.0	0	4,561	0	0	5,902

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

	• • • • • • • • • •	*******		E Q	UIPI	HENT	ENE	RGY	CONS	UMPTI	ON		• • • • • • • • • • • • • • • • • • • •	
ef	Equip			• • • • • • • • • • • • • • • • • • • •		Mon	thly Con	sumption						
lum	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ1001S		2-5	TG CENTRI	FUGAL	CHILLER	<550 TON	s						44
	ELEC	0	0	0	0	89514	103432	122331	127030	103190	50187	0	0	595,685
	PK	0.0	0.0	0.0	0.0	286.9	267.5	299.6	319.9	290.4	193.8	0.0	0.0	319.9
1	EQ5100		COOL	ING TOWER	RFANS									
	ELEC	0	0	0	0	11100	10742	11100	11100	10742	5429	0	0	60,215
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9
1	EQ5100		COOL	ING TOWER	R FANS									
	WATER	0	0	0	0	483	569	673	694	561	270	0	0	3,251
	PK	0.0	0.0	0.0	0.0	1.6	1.5	1.6	1.7	1.6	1.2	0.0	0.0	1.7
1	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	Ō	0	0	0	22201	21485	22201	22201	21485	22201	0	0	131,773
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010		COND	ENSER WA	TER PUM	P-CV(HIG	H EFFIC.)						
	ELEC	0	0	0	0	16651	16114	16651	16651	16114	16651	0	0	98,830
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	EQ5300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2	EQ1001S		2-5	TG CENTR	I FUGAL	CHILLER	<550 TO	ıs						
	ELEC	0	0	0	0	216416	259295	314252	325517	256609	91916	0	0	1,464,005
	PK	0.0	0.0	0.0	0.0	524.9	541.9	549.8	556.5	540.7	371.9	0.0	0.0	556.5
2	EQ5100		COOL	ING TOWE	R FANS									
	ELEC	0	0	0	ō	38852	37598	38852	38852	37598	19065	0	0	210,817
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.2
2	EQ5100		COOL	.ING TOWE	R FANS									
	WATER	0	0	0	Ō	1007	1274	1584	1663	1224	387	0	0	7,140
	PK	0.0	0.0	0.0	0.0	3.1	3.3	3.8	4.0	3.5	1.9	0.0	0.0	4.0
2	E95001		CHIL	LED WATE	R PUMP	- CONST	TANT VOLI	JME						
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,35
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.
2	EQ5010		CON	DENSER WA	TER PU	P-CV(HI	GH EFFIC	.)						
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	22201	0	0	131,77
	PK	0,0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

BASE CASE

ef	Equip			• • • • • • • •		Mon	thly Cons	sumption					• • • • • •	
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2	EQ5300		CONT	TROL PANE	L & INTE	RLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLUM	ſΕ						
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
3	EQ1001S		2-9	STG CENT	RIFUGAL (CHILLER	<550 TONS	3						
	ELEC	0	0	0	0	6503	20559	38934	48240	16050	0	0	0	130,286
	PK	0.0	0.0	0.0	0.0	165.4	210.0	305.1	347.3	234.0	0.0	0.0	0.0	347.3
3	EQ5001		CHI	LLED WATE	ER PUMP	- CONST	ANT VOLUM	1E						
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ5010		CON	DENSER W	ATER PUM	P-CV(HIG	H EFFIC.)						
	ELEC	0	0	0	0	2626	4715	9250	9489	5073	0	0	0	31,153
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	0.0	0.0	0.0	29.8
3	EQ5300		CONT	TROL PANE	EL & INT	ERLOCKS								
	ELEC	0	0	0	0	88	158	310	318	170	0	0	0	1,044
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
1			030	185.04 B	LDG 1350	HWH BOI	LER 1							
	GAS	5565	5263	5068	4904	0	0	0	0	0	0	4904	5696	31,400
	PK	13.2	13.9	6.8	6.8	0.0	0.0	0.0	0.0	0.0	0.0	6.8	11.4	13.9
1	EQ5020		HEAT	TING WAT	ER CIRCU	LATION P	UMP							
	ELEC	22201	20052	22201	21485	0	0	0	0	0	0	21485	22201	129,625
	PK	29.8	29.8	29.8	29.8	0.0	0.0	0.0	0.0	0.0	0.0	29.8	29.8	29.8
1	EQ5311		BOIL	LER CONTI	ROLS									
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
2			030	185.04 B	LDG 1350	HWH BOI	LER 2							
	GAS	0	0	0	0	0	0	0	0	0	0	O	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ5311		BOIL	LER CONT	ROLS									
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 BASE CASE

ef	Equip					Mont	hly Cons	umption ·	• • • • • • • • • • • • • • • • • • • •					
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
3			030	185.04 AF	REA 1300	HWH BOIL	ER(S)							
	GAS	36755	35443	18831	11935	0	0	0	0	0	0	17631	35518	156,11
	PK	81.9	79.4	53.4	19.2	0.0	0.0	0.0	0.0	0.0	0.0	52.2	76.6	81.
3	EQ5020		HEAT	TING WATE	ER CIRCUL	ATION PU	MP							
	ELEC	8325	7520	8325	8057	0	0	0	0	0	0	8057	8325	48,60
	PK	11.2	11.2	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.
3	EQ5311		8011	LER CONT	ROLS									
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	54
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
3	EQ5020		HEA	TING WAT	ER CIRCUL	ATION PL	IMP							
	ELEC	8325	7520	8325	8057	0	0	0	0	0	0	8057	8325	48,60
	PK	11.2	11.2	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.
3	EQ5240		BOI	LER FORC	ED DRAFT	FAN								
	ELEC	5550	5013	5550	5371	0	0	0	0	0	0	5371	5550	32,40
	PK	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.
4			030	185.04 A	REA 1300	HWH BOIL	ER(S)							
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	EQ5020		HEA	TING WAT	ER CIRCUL	ATION PL	JMP							
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
4	EQ5311		BOI	LER CONT	ROLS									
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
4	EQ5240		BOI	LER FORC	ED DRAFT	FAN								
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3 WATER COOLED CENTR. CHILLER, EXIST BOILR

				E	QUIP	MENT	ENE	RGY	CONS	UMPT	1 O N			••••••
Ref	Equip					Mon	thly Con	sumption						
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	248076	224754	249404	239859	248740	241188	247411	249404	239859	248740	241187	241432	2,920,053
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	Ō
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	ō
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	Ō	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BAS	SE UTILI	ΓY									
	CHILLD	0	0	0	0	16368	15840	16368	16368	15840	16368	0	0	97,152
	PK	0.0	0.0	0.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	22.0
2			BA	SE UTILI	TY									
	CHILLD	0		0	0	31992	30960	31992	31992	30960	31992	0	0	189,888
	PK	0.0	0.0	0.0	0.0	43.0	43.0	43.0	43.0	43.0	43.0	0.0	0.0	43.0
1	EQ1001S		2	-STG CEN	TRIFUGAL	CHILLER	<550 TO	ıs						
	ELEC	0		0	0	70092	85728	108560	96704	93491	62989	0	0	517,565
	PK	0.0	0.0	0.0	0.0	268.8	287.1	326.8	330.2	307.2	276.6	0.0	0.0	330.2
1	E95100		co	OLING TO	WER FANS									
	ELEC	0		0	0	6863	6058	6669	5804	7311	4499	0	0	37,204
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
WATER COOLED CENTR. CHILLER, EXIST BOILR

					0 1 1	n E n 1	ENE	KUI	CUNS	UMPI	1 O N			
₹ef	Equip				• • • • • •	Mor	thly Cor	sumption						
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
1	EQ5100		COOL	ING TOWE	R FANS									
	WATER	0	0	0	0	397	484	600	528	527	354	0	0	2,89
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.7	1.7	1.6	1.6	0.0	0.0	1.
1	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	13726	12115	13338	11608	14622	19694	0	0	85,10
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010		COND	ENSER WA	TER PUM	P-CV(HIG	H EFFIC.)						
	ELEC	0	0	0	0	10295	9086	10004	8706	10966	14771	0	0	63,828
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	E95300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	460	406	447	389	490	660	0	0	2,85
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2			YORK	CENTRIF	UGAL R-	134A CHI	LLER							
	ELEC	0	0	0	0	124154	158702	198246	223687	144780	18405	0	0	867,97
	PK	0.0	0.0	0.0	0.0	437.4	453.1	475.2	479.0	446.8	373.4	0.0	0.0	479.1
2	EQ5100		COOL	ING TOWE	R FANS									
	ELEC	0	0	0	0	19418	26204	31685	35131	24534	4385	o	0	141,358
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.2
2	EQ5100		COOL	ING TOWE	R FANS									
	WATER	0	0	0	0	884	1133	1401	1562	1034	146	0	0	6,160
	PK	0.0	0.0	0.0	0.0	3.0	3.0	3.1	3.1	3.0	2.7	0.0	0.0	3.
2	EQ5001		CHILI	LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5011		COND	ENSER WA	TER PUM	P-CV(MED	IUM EFFI	C.)						
	ELEC	0	0	0	Ō	20813	28087	33962	37654	26297	4700	0	0	151,51
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.
2	EQ5300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	372	502	607	673	470	84	0	0	2,708
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 WAT. COOLED GAS ENGINE CHLR, EXIST BOILR

f	Equip					Mon	thly Con	sumption						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	248076	224754	249404	239859	248740	241188	247411	249404	239859	248740	241187	241432	2,920,05
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
2	MISC LD													
	GAS	0	O	0	0	0	0	0	0	0	C	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	O	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1			BAS	SE UTILIT	ſΥ									
	CHILLD	0	0	0	0	16368	15840	16368	16368	15840	16368	0	0	97,15
	PK	0.0	0.0	0.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	22.
2			BAS	SE UTILI	ſΥ									
	CHILLD	0		0	0	31992	30960	31992	31992	30960	31992	0	0	189,88
	PK	0.0	0.0	0.0	0.0	43.0	43.0	43.0	43.0	43.0	43.0	0.0	0.0	43.
1	EQ1001S						<550 TO							
	ELEC	0		0	0	70092		108560	96704	93491	62989	0		517,56
	PK	0.0	0.0	0.0	0.0	268.8	287.1	326.8	330.2	307.2	276.6	0.0	0.0	330.
1	EQ5100			DLING TO										
	ELEC	0			0	6863	6058	6669	5804	7311	4499	0	0	37,20
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 WAT. COOLED GAS ENGINE CHLR, EXIST BOILR

				E Q	UIPN	RENT	ENER	G Y C	оиѕ	JMPTI	O N			
Ref	Equip					Mon	thly Cons	sumption						
	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5100		COOL	ING TOWER	FANS									
	WATER	0	0	0	0	397	484	600	528	527	354	0	0	2,891
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.7	1.7	1.6	1.6	0.0	0.0	1.7
1	EQ5001		CHIL	LED WATER	PUMP -	- CONST	ANT VOLUM	4E						
	ELEC	0	0	0	0	13726	12115	13338	11608	14622	19694	0	0	85,104
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010		COND	ENSER WAT	TER PUMP	P-CV(HIG	H EFFIC.)						
	ELEC	0	0	0	0	10295	9086	10004	8706	10966	14771	0	0	63,828
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	EQ5300		CONT	ROL PANEI	. & INT	ERLOCKS								
	ELEC	0	0	0	0	460	406	447	389	490	660	0	0	2,852
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2			YORK	ENGINE I	ORIVEN (CHILLER								
	GAS	0	0	0	0	12610	16173	20369	23139	14796	1774	0	0	88,860
	PK	0.0	0.0	0.0	0.0	45.0	47.4	50.6	51.3	47.0	36.7	0.0	0.0	51.3
2	EQ5100		COOL	ING TOWER	R FANS									
	ELEC	0	0	0	0	19418	26204	31685	35131	24534	4385	0	0	141,358
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.2
2	EQ5100		COOL	ING TOWE	R FANS									
	WATER	0	0	0	0	996	1278	1584	1772	1166	160	0	0	6,957
	PK	0.0	0.0	0.0	0.0	3.4	3.5	3.6	3.6	3.4	3.1	0.0	0.0	3.6
2	EQ5001			LED WATE			ANT VOLU	ME						
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5011		COND	ENSER WA	TER PUM	P-CV(MED	IUM EFFI	C.)						
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	372	502	607	673	470	84	0	0	2,708
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3 W.C. CENTRIFUGAL VFD CHILLER, EXIST BLR

ef	Equip					Mon	thly Con	sumption						
	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	248076	224754	249404	239859	248740	241188	247411	249404	239859	248740	241187	241432	2,920,053
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	ō	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0		0	0	0	0	0	0	0	0	0	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1				SE UTILI										
	CHILLD	0		0	0	16368	15840	16368	16368	15840	16368	0	_	97,152
	PK	0.0	0.0	0.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	22.0
2				SE UTILI										
	CHILLD	0		0	0	31992	30960	31992	31992	30960	31992			189,88
	PK	0.0	0.0	0.0	0.0	43.0	43.0	43.0	43.0	43.0	43.0	0.0	0.0	43.0
1	EQ1001S			-STG CEN										
	ELEC	0		-	0	70092	85728		96704	93491	62989			517,56
	PK	0.0	0.0	0.0	0.0	268.8	287.1	326.8	330.2	307.2	276.6	0.0	0.0	330.
1	EQ5100			OLING TO										
	ELEC	0			0	6863			5804	7311				37,20
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3 W.C. CENTRIFUGAL VFD CHILLER, EXIST BLR

Ref	Equip					Mont	hly Cons	umption						
	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5100		COOL 1	NG TOWER	FANS									
	WATER	0	0	0	0	397	484	600	528	527	354	0	0	2,891
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.7	1.7	1.6	1.6	0.0	0.0	1.7
1	EQ5001		CHILL	ED WATER	PUMP	CONST	ANT VOLUM	E						
	ELEC	0	0	0	0	13726	12115	13338	11608	14622	19694	0	Ō	85,104
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010		CONDI	ENSER WA	TER PUM	-CV(HIG	H EFFIC.)						1
	ELEC	0	0	0	0	10295	9086	10004	8706	10966	14771	0	0	63,828
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	EQ5300		CONT	ROL PANE									_	
	ELEC	0	0	0	0	460	406	447	389	490	660	0	0	2,852
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2	YCENVFD		YORK				REQ. DRI						_	T
	ELEC	0	0	0			147760				15891	0	0	811,935 479.1
	PK	0.0	0.0	0.0	0.0	419.5	441.7	472.9	479.0	437.2	340.0	0.0	0.0	479.0
2	EQ5100		COOF	ING TOWE	R FANS								_	
	ELEC	0	0	0	Ø	19426	26214	31698	35144	24543	4386	0	0	141,41
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.
2	EQ5100		COOL	ING TOWE	R FANS									
	WATER	0	0	0	0	876	1123	1390	1551	1025	143	0	0	6,10
	PK	0.0	0.0	0.0	0.0	3.0	3.0	3.1	3.1	3.0	2.7	0.0	0.0	3.
2	EQ5001			LED WATE			TANT VOLU					_		
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,51
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.
2	EQ5011		CON				IUM EFFI					_	_	
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,51
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.
2	EQ5300		CON	TROL PAN									_	
	ELEC	0	0	0	0			607		470	84	0	0	2,70
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.

Trane Air Conditioning Economics
By: HUITT & ZOLLARS

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4 WAT. COOLED DUAL SCREW CHILR, EXIST BLR

ef	Equip					Mon	thly Con	sumption						
	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
_														
0	LIGHTS ELEC	248076	224754	249404	239859	248740	241188	247411	2/0/0/	239859	2/87/0	241187	241432	2,920,053
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0
	1.	00710	007.10	007.0	00710	337.5	007.0	007.0	007.0	007.0	507.10	00710	00710	55715
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	O	0	C
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH20	0		0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1			BAS	SE UTILI	TY									
	CHILLD	0	_	-	-		15840	16368	16368	15840	16368	Ö	0	97,15
	PK	0.0	0.0	0.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	22.
2				SE UTILI										
	CHILLD	0	-	_	-		30960	31992	31992	30960	31992		_	189,88
	PK	0.0	0.0	0.0	0.0	43.0	43.0	43.0	43.0	43.0	43.0	0.0	0.0	43.
1	Eq1001s		2	-STG CEN	TR I FUGAL	CHILLER	<550 TO	4S						
	ELEC	0	_	0	0		85728		96704	93491	62989	-		517,56
	PK	0.0	0.0	0.0	0.0	268.8	287.1	326.8	330.2	307.2	276.6	0.0	0.0	330.
1	EQ5100		co	OLING TO	WER FANS									
	ELEC	0	_	-				6669	5804	7311	4499		_	37,20
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4 WAT. COOLED DUAL SCREW CHILR, EXIST BLR

----- EQUIPMENT ENERGY CONSUMPTION -----Ref Equip ----- Monthly Consumption -----Num Code Jan Mar Apr May June July Aug Sep Oct Total 1 EQ5100 COOLING TOWER FANS WATER 0 0 0 0 397 484 600 528 527 354 0 0 2,891 0.0 1.5 0.0 PK 0.0 0.0 0.0 1.5 1.7 1.7 1.6 1.6 0.0 1.7 1 EQ5001 CHILLED WATER PUMP - CONSTANT VOLUME 0 13726 12115 13338 85,104 0 11608 14622 19694 0 FLEC 0 n Ω PK 0.0 0.0 0.0 0.0 29.8 29.8 29.8 29.8 29.8 0.0 0.0 29.8 1 EQ5010 CONDENSER WATER PUMP-CV(HIGH EFFIC.) 0 0 10295 9086 10004 8706 10966 14771 0 0 63,828 ELEC 0 PK 0.0 0.0 0.0 0.0 22.4 22.4 22.4 22.4 22.4 22.4 0.0 0.0 22.4 1 EQ5300 CONTROL PANEL & INTERLOCKS ELEC ٥ n 0 0 460 406 447 389 400 0 n 2,852 660 0.0 0.0 PK 0.0 0.0 1.0 1.0 1.0 1.0 1.0 1.0 0.0 0.0 1.0 2 YSCRW22 YORK W.C. SCREW CHILLER ELEC 0 0 0 131905 167567 210224 238248 150736 18266 0 0 916,945 PK 0.0 0.0 483.0 500.4 524.8 0.0 0.0 529.0 493.4 412.3 0.0 0.0 529.0 2 EQ5100 COOLING TOWER FANS 141,412 19426 26214 24543 ELEC 0 O 0 0 31698 35144 4386 0 0 PK 0.0 0.0 52.2 52.2 52.2 0.0 0.0 52.2 52.2 52.2 52.2 0.0 0.0 2 EQ5100 COOLING TOWER FANS WATER 0 0 0 0 891 1142 1412 1576 1039 145 ō 0 6,204 PK 0.0 0.0 0.0 0.0 3.0 3.1 3.1 3.1 3.0 2.8 0.0 0.0 3.1 2 EQ5001 CHILLED WATER PUMP - CONSTANT VOLUME ELEC 0 0 0 20813 28087 33962 37654 26297 4700 0 0 151,513 PK 0.0 0.0 0.0 56.0 0.0 0.0 56.0 56.0 56.0 56.0 56.0 56.0 0.0 2 EQ5011 CONDENSER WATER PUMP-CV(MEDIUM EFFIC.) 151,513 ELEC 0 0 0 0 20813 28087 33962 37654 26297 4700 n n PK 0.0 0.0 0.0 56.0 56.0 56.0 56.0 56.0 56.0 0.0 0.0 56.0 2 EQ5300 CONTROL PANEL & INTERLOCKS ELEC Ō 0 0 0 372 502 607 673 470 84 0 0 2,708 PK 0.0 0.0 0.0 0.0 1.0 0.0 1.0 1.0 1.0 1.0 1.0 1.0 0.0

PK

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 EXISTING CHILLERS, HIGH % MODULAR BOILES

------EQUIPMENT ENERGY CONSUMPTION ----------- Monthly Consumption -----Ref Equip Total June July Aug Sep Oct Nov Mar Apr May Num Code Jan Feb 0 LIGHTS 248076 224754 249404 239859 248740 241188 247411 249404 239859 248740 241187 241432 2,920,053 ELEC 689.0 689.0 689.0 689.0 689.0 689.0 689.0 689.0 PK 689.0 689.0 689.0 1 MISC LD 0 0 0 0 0 ٥ 0 ELEC 0 0 ۵ 0 0 0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 PK 2 MISC LD 0 0 0 0 0 0 0 0 0 0 0 0 GAS 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 PK 3 MISC LD 0 0 n 0 0 0 0 0 0 0 0 ٥ O OIL 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 PK 4 MISC LD O 0 0 0 n 0 0 0 0 0 P STEAM 0 0 0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 PΧ 0.0 5 MISC LD 0 0 0 0 Ď 0 0 P HOTH20 0 0 0 0 ٥ 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 PK 0.0 0.0 0.0 6 MISC LD 0 0 0 0 0 P CHILL 0 0 0 0 0 0 0 0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 PK 0.0 0.0 0.0 0.0 0.0 0.0 BASE UTILITY 77,992 0 O 0 12927 13358 Ō 0 0 13358 12065 13358 12927 HOTLD 18.0 18.0 18.0 0.0 0.0 18.0 18.0 18.0 18.0 0.0 0.0 0.0 0.0 PK HIGH EFFICIENCY MODULAR FIRETUBE BOIL. 86,323 0 0 0 0 14257 14880 14725 14142 0 0 14880 13440 GAS 20.0 0.0 20.0 20.0 20.0 0.0 0.0 0.0 0.0 0.0 20.0 20.0 20.0 PΚ HEATING WATER CIRCULATION PUMP 1 EQ5020 O 0 4032 4166 24,326 n 4166 3763 4166 4032 0 O 0 ELEC 5.6 0.0 0.0 0.0 0.0 0.0 0.0 5.6 5.6 5.6 5.6 5.6 PK 5.6 1 EQ5311 BOILER CONTROLS 543 90 93 0 0 0 0 n O 93 90 93 ELEC 84 0.1 0.1 0.1 0.0 0.0 0.1 0.1 0.1 0.1 0.0 0.0 0.0 0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 EXISTING CHILLERS, HIGH % MODULAR BOILES

				E Q	UIPH	ENT	ENER	G Y C	ONSU	меті	O N			••••••
Ref	Equip					Mont	hly Cons	umption -				• • • • • • • • • • • • • • • • • • • •		
Num		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2		-, "	HIGH	EFFICIE	NCY MODU	LAR FIRE	TUBE BOI	ι.						
	GAS	10665	11051	4016	9	0	0	0	0	0	0	3581	10438	39,761
	PK	20.0	20.0	20.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	20.0	20.0	20.0
2	EQ5020		HEAT	ING WATE	R CIRCUL	ATION PL	IMP							
	ELEC	4166	3763	1870	84	0	0	0	0	0	0	1691	4166	15,742
	PK	5.6	5.6	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	5.6
2	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	93	84	42	2	0	0	0	0	0	0	38	93	351
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
3			HIGH	H EFFICIE	NCY MODU	LAR FIRE	TUBE BOI	L.						
	GAS	6138	6228	383	0	0	0	0	0	0	0	234	6204	19,188
	PK	20.0	20.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	20.0	20.0
3	EQ5020		HEA	TING WATE	R CIRCUL	ATION P	UMP							
	ELEC	2195	2150	510	0	0	0	0	0	0	0	342	2307	7,504
	PK	5.6	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	5.6
3	EQ5311		BOI	LER CONTR	OLS									
	ELEC	49	48	11	0	0	0	0	0	0	0	8	52	167
	PK	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
4			HIG	H EFFICIE	ENCY MODI	JLAR FIR	ETUBE BO	IL.						
	GAS	1004	722	0	0	0	0	0	0	0	0	0	313	2,039
	PK	9.9	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	9.9
4	EQ5020		HEA	TING WATE	ER CIRCU	LATION P	UMP							
	ELEC	1086	1053	0	0	0	0	O	0	0	0	0	818	2,957
	PK	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6
4	EQ5311		801	LER CONTI	ROLS									
	ELEC	24	23	0	0	0	0	0	0	0	0	0	18	66
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

01 Card - Job Information

Project: 03018504 EEAP BOILER-CHILLER STUDY Location: FT. SAM HOUSTON - SAN ANTONIO, TX. Client: CORPS OF ENGINEERS - FORT MORTH, TEXAS

Program User: HUITT - ZOLLARS INC.

Comments: AREA 2200

----- Load Section Alternative #1 -----

Card 19- Load Alternative -Number Description 1 AREA 2200

Card 20-----
Zone

General Room Parameters -----
Acoustic Floor to Duplicate Duplicate Perimeter

	Zone						Acoustic	Floor to	Duplicate	Duplicate	Perimet
Room	Reference	Room	Floor	Floor	Const	Plenum	Ceiling	Floor	Floors	Rooms per	Depth
Number	Number	Descrip	Length	Width	Type	Height	Resistance	Height	Multiplier	Zone	
5	5	BLDG 2263	264	265	3	3	2.54	11			
15	15	DINING 2265	77	77	3	2.5	2.54	11			
20	20	BARR 2265	299	299	3	2.5	2.54	11			
25	25	ADMIN 2264	221	222	3	2.5	2.54	11			
30	30	BARR 2264	221	222	3	2.5	2.54	11			
35	35	ADMIN 2266	221	222	3	2.5	2.54	11			
40	40	BARR 2266	221	222	3	2.5	2.54	11			

Card 21----- Thermostat Parameters
 Cooling
 Room
 Cooling
 Cooling
 Heating
 Heating
 T'stat
 Hass / Carpet

 Room
 Design
 T'stat
 T'stat
 T'stat
 T'stat
 Location
 No. Hrs
 On
 T'stat Location No. Hrs On Room Room Number Design DB RH Driftpoint Schedule Design DB Driftpoint Schedule Flag Average Floor 70 70 5 78 50 78 LIGHT30 YES ROOM 15 78 50 78 70 70 ROOM LIGHT30 NO 70 20 78 50 78 70 LIGHT30 YES ROOM

Card 21				Therm	ostat Param	eters				•••••
	Cooling	Room	Cooling	Cooling	Heating	Heating	Heating	T'stat	Mass /	Carpet
Room	Room	Design	T'stat	T'stat	Room	T'stat	T'stat	Location	No. Hrs	On
Number	Design DB	RH	Driftpoint	Schedule	Design DB	Driftpoint	Schedule	Flag	Average	Floor
25	78	50	78		70	70		ROOM	LIGHT30	YES
30	78	50	78		70	70		ROOM	LIGHT30	YES
35	78	50	78		70	70		ROOM	LIGHT30	YES
40	78	50	78		70	70		ROOM	LIGHT30	YES

Card 22				Roof Par	ameters			• • • • • •	
		Roof							
Room	Roof	Equal to	Roof	Roof	Roof	Const	Roof	Roof	Roof
Number	Number	Floor?	Length	Width	U-Value	Type	Direction	Tilt	Alpha
5	1	NO	164	164	.09	37		80	
20	1	NO	165	166	.09	37		80	
30	1	NO	165	166	.09	37		80	
40	1	NO	165	166	.09	37		80	

Card 24	,			Wall P	arameters		•••••		
					Wall				Ground
Room	Wall	Wall	Wall	Wall	Constuc	Wall	Wall	Wall	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
5	1	924	11	.49	74	0		.74	
5	2	414	11	.49	74	90		.74	
5	3	924	11	.49	74	180		.74	
5	4	414	11	.49	74	270		.74	
15	1	309	11	-41	94	0		.74	
20	1	810	11	.41	94	0		.74	
20	2	243	11	.41	94	90		.74	
20	3	810	11	.41	94	180		.74	
20	4	243	11	.41	94	270		.74	
25	1	357	11	.41	94	0		.74	
25	2	81	11	.41	94	90		.74	
25	3	357	11	.41	94	180		.74	
25	4	81	11	.41	94	270		.74	
30	1	714	11	-41	94	0		.74	
30	2	162	11	.41	94	90		.74	
30	3	714	11	.41	94	180		.74	
30	4	162	11	-41	94	270		.74	
35	1	357	11	.41	94	0		.74	
35	2	81	11	-41	94	90		.74	
35	3	357	11	.41	94	180		.74	
35	4	81	11	.41	94	270		.74	
40	1	714	11	.41	94	0		.74	
40	2	162	11	.41	94	90		.74	
40	3	714	11	.41	94	180		.74	
40	4	162	11	.41	94	270		.74	

				Pct Glass			External	Internal	Percent		Inside
Room	Wall	Glass	Glass	or No. of		Shading		Shading		Visible	Visible
Number	Number	Length	Width	Windows		Coefficient	-	Туре		Transmittance	
5	1	3	6	97	1.1	.67	•				
5	2			16	.63	1					
5	3			32	.57	1					
5	4			16	.63	1					
15	1	3	6	35	1.1	.67					
20	1	3	6	82	1.1	.67					
20	2	3	6	27	1.1	.67					
20	3	3	6	96	1.1	.67	3				
20	4	3	6	27	1.1	.67					
25	1	3	6	41	1.1	.67					
25	2	3	6	9	1.1	.67					
25	3	3	6	48	1.1	.67	3				
25	4	3	6	9	1.1	.67					
30	1	3	6	82	1.1	.67					
30	2	3	6	18	1.1	.67					
30	3	3	6	96	1.1	.67	3				
30	4	3	6	18	1.1	.67					
35	1	3	6	41	1.1	.67					
35	2	3	6	9	1.1	.67					
35	3	3	6	48	1.1	.67	3				
35	4	3	6	9	1.1	.67	_				
40	1	3	6	82	1.1	.67					
40	2	3	6	18	1.1	,67					
40	3	3	6	96	1.1	.67	3				
40	4	3	6	18	1.1	.67	-				

Room					Reheat	Cooling	Heating	Auxiliary	Room	Daylighting
Number	Peopl e	Lights	Ventilation	Infiltration	Minimum	Fans	Fan	Fan	Exhaust	Controls
5	FSHOFF1C	FSHOFFIC								
15	FSHDINP	FSHDINL								
20	FSHBARRP	FSHBARRL								
25	FSHOFFIC	FSHOFFIC								
30	FSHBARRP	FSHBARRL								
35	FSHOFFIC	FSHOFFIC								
40	FSHBARRP	FSHBARRL								

Card 27	'				Peopl	e and Ligh	ts				• • • • • • • • • • • • • • • • • • • •
							Lighting		Percent	Daylig	hting
Room	Peopl e	People	People	People	Lighting	Lighting	Fixture	Ballast	Lights to	Reference	Reference
Number	Value	Units	Sensible	Latent	Value	Units	Type	Factor	Ret. Air	Point 1	Point 2
5	250	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
15	400	PEOPLE	275	275	1.3	WATT-SF	ASHRAE2				

Number V 20 2 25 4	People Pe					_	_	hting		Perce		-	ghting -		
20 2 25 4 30 3			•	•	Lighting	_	nting Fix			-			Referen		
25 4 30 3		nits	Sensible			Uni	• • • • • • • • • • • • • • • • • • • •		actor	Ret.	Air Po	oint 1	Point 2	2	
30 3			250	200	.8			RAEZ							
		OPLE	250	200	2.0			RAE2							
J) 4		OPLE	250	200	.8 2.0			RAEZ							
40 3		OPLE OPLE	250 250	200 200	.8			RAE2 RAE2							
,,			230	200	.0	•••	, or 23.	NA 6							
							cellaneous						•	•••••	
	Misc				rgy Ene			Energy			Percent		cent		
	Equipment						Schedule						c. Sens		•
Number N 5 1	Number 1	Descr'	•	Vale 1			Code	Code	Sens	sible	to Room	to	KET. AIF	Fraction	Air Pat
5 I 15 I		DIN. I		1			FSHOFFIC								
20 1		T.V.		1			FSHDINL FSHBARRL								
	1	COMPU		1			FSHOFFIC								
	1	T.V.		i			FSHBARRL								
35 1		COMPU'		1			FSHOFFIC								
	1	T.V.		1			FSHBARRL								
Card 29						Poom	Airfloue								
-		Ve	ntilation-					Infiltra	tion						
Room -	Cool	ing	ntilation-	·Heating			-Cooling	Infiltra 	tion	eating-		Rehe	eat Minim	um	
Room - Number V	Cool	ing Unit	ntilation s Valu	Heating	Units		-Cooling	Infiltra 	tion	eating-			eat Minim		
Room - Number V 5 2	Cool	ing	ntilation- s Value P 20	Heating			-Cooling	Infiltra 	tion	eating-		Rehe	eat Minim	um	
Room - Number V 5 2 15 2	Cool Value 20	ing Unit: CFM-	ntilation- s Value P 20 P 20	Heating	Units CFM-P		-Cooling	Infiltra 	tion	eating-		Rehe	eat Minim	um	
Room - Number V 5 2 15 2 20 2	Cool Value 20	ing Unit: CFM-I	ntilation s Value P 20 P 20 P 20	Heating	Units CFM-P		-Cooling	Infiltra 	tion	eating-		Rehe	eat Minim	um	
Room - Number V 5 2 15 2 20 2 25 2	Cool Value 20 20	ing Unit: CFM-I CFM-I	ntilation s Value P 20 P 20 P 20 P 20	Heating	Units CFM-P CFM-P		-Cooling	Infiltra 	tion	eating-		Rehe	eat Minim	um	
Room - Number V 5 2 15 2 20 2 25 2 30 2	Cool Value 20 20 20 20	ing Unit: CFM-I CFM-I CFM-I	ntilation s Value P 20	Heating	Units CFM-P CFM-P CFM-P		-Cooling	Infiltra 	tion	eating-		Rehe	eat Minim	um	
Room - Number V 5 2 15 2 20 2 25 2 30 2 35 2	Cool Value 20 20 20 20 20 20	ing Unit: CFM-! CFM-! CFM-! CFM-!	ntilation s Value P 20	Heating	Units CFM-P CFM-P CFM-P CFM-P		-Cooling	Infiltra 	tion	eating-		Rehe	eat Minim	um	
Room - Number V 5 2 15 2 20 2 25 2 30 2 335 2 40 2	Cool Value 20 20 20 20 20 20 20	OFM-: OFM-: OFM-: OFM-: OFM-: OFM-: OFM-: OFM-: Above	ntilation s Value P 20	Heating	Units CFM-P CFM-P CFM-P CFM-P CFM-P CFM-P CFM-P CFM-P	Valu	-Coolinge Ur	Infiltra	tion	eating- U	Addion Bu	Rehe Value	eat Minim	um	

Card 39- System Alternative

Description

Number

EXISTING SYSTEM Card 40----- System Type -----------OPTIONAL VENTILATION SYSTEM-----Ventil Set System Deck Cooling Heating Cooling Heating Static Number Type Location SADBVh SADBVh Schedule Schedule Pressure 1 SZ Card 41----- Zone Assignment System Ref #2 Set Ref #1 Ref #3 Ref #4 Ref #5 Ref #6 Begin End Begin End Begin End Begin End Number Begin End Begin End 1 5 40 Card 42----- Fan SP and Duct Parameters-----System Cool Heat Return Mn Exh Aux Rm Exh Cool Return Supply Supply Return Set Fan Fan Fan Fan Fan Fan Fan Mtr Fan Mtr Duct Duct Air Number SP SP SP SP SP Loc Loc Ht Gn Loc Path 1 2 2 Card 45----- Equipment Schedules -----System Main Direct Indirect Auxiliary Main Main Auxiliary Set Cooling Evap Evap Cooling Heating Preheat Reheat Mech. Heating Number Coil Economizer Coil Coil Coil Coil Coil Humidity Coil 1 FISAMCLG FISAMCTG FISAMCTG ----- Equipment Section Alternative #1 -----Card 59----- Equipment Description / TOD Schedules ------Elec Consump Elec Demand Demand ---- Demand Limit ---Alternative Time of Day Time of Day Limit Temperature Number Schedule Schedule Max KW Alternative Description Schedule Drift BASE CASE Card 60------ Cooling Load Assignment------Load All Coil Cooling Asgn Loads To Equipment -Group 1- -Group 2- -Group 3- -Group 4- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-Ref Coot Ref Sizing Begin End BLKPLANT 1 1

ool I	Equip	Num		(COOLING	•••••	•••••	HEAT RECO	VERY		Seq		Demand	d E
ef (Code	Of	Cap	oacity	E	nergy	Capacii	ty	Energy	·	Order	Seq	Limit	
um I	Name	Units	Value	Units	Value	Units	Value Ur	nits	Value l	Jnits	Num	Type	Number	г
'	EQ1001L	1	657	TONS	595	KW								
					_	•	References EC or AUX			•••••				
							ed Full Load		Cold	Cooling	Misc			
	Value	Units		Value	Units	Value	Units		Storage	-	Acces			
	74.6	KW		37.3	KW	74,42		55.11.1		1	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	••		
oad ssig	Al	l Coil ads To	-(Group 1-	-Group 2-	-Group 3-	Load Assign -Group 4- Begin End	-Group 5	- Group	6Grou				
	1		1	1										
eat ef	67 Equip Code r Name	Nui Of	mber 1	HW Pmp Full Ld Value	Units	Heating Cap'y Value Unit	Equipment Pa Energy Rate s Value		Seq Order	Switch over Control	Hot	Misc.	Cogen	Dem Lim
eat ef umbe	Equip Code	Nui Of Un	mber 1 its 1	HW Pmp Full Ld		Cap'y	Energy Rate		Seq Order	Switch over	Hot Strg	Misc.		Lim
eat ef umbe	Equip Code r Name	Nu Of Un ST 1	mber 1 its 1	HW Pmp Full Ld Value	Units	Cap'y Value Unit	Energy Rate s Value	Units	Seq Order Number	Switch over	Hot Strg	Misc.		Lim
eat ef umbe	Equip Code r Name 2200E)	Num Of Un ST 1	mber 1	HW Pmp Full Ed Value 11.19	Units KW	Cap'y Value Unit 2240 MBH	Energy Rate s Value 3000	Units MBH	Seq Order Number 1	Switch over	Hot Strg	Misc. Acc.		Lim
eat ef umbe	Equip Code Name 2200E) 2200E)	Num Of Un ST 1 ST 1	its !	HW Pmp Full Ld Value 11.19 11.19	Units KW KW KW	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH	Energy Rate S Value 3000 3000 3000	Units MBH MBH MBH	Seq Order Number 1 2 3	Switch over	Hot Strg	Misc. Acc. 1		Lim
eat ef umbe	Equip Code Name 2200E) 2200E)	Num Of Un ST 1 ST 1	its !	HW Pmp Full Ed Value 11.19 11.19	Units KW KW KW	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH	Energy Rate s Value 3000 3000 3000	Units MBH MBH MBH	Seq Order Number 1 2 3	Switch over	Hot Strg	Misc. Acc. 1		Lim
eat ef umbe ard ase	Equip Code r Name 2200EX 2200EX	Num Of Un ST 1 ST 1	its !	HW Pmp Full Ld Value 11.19 11.19	Units KW KW KW Bas y Hourly	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH	Energy Rate S Value 3000 3000 3000	Units MBH MBH MBH	Seq Order Number 1 2 3	Switch over Control	Hot Strg	Misc. Acc. 1 2 3		Lim
eat ef umbe ard ase	Equip Code r Name 2200E) 2200E) 2200E) 71	Num Of Un ST 1 ST 1 ST 1	its !	HW Pmp Full Ed Value 11.19 11.19 11.19	Units KW KW KW Bas y Hourly d Demanx	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH	Energy Rate S Value 3000 3000 3000 arameters Energy R	Units MBH MBH MBH	Seq Order Number 1 2 3	Switch over Control	Hot Strg	Misc. Acc. 1 2 3		Lim
eat ef umbe	Equip Code Name 2200E) 2200E) 71 Base ty Utilian Description	Num Of Un ST 1 ST 1 ST 1	mber 1	HW Pmp Full Ld Value 11.19 11.19 11.19 Hourl	Units KW KW KW Bas y Hourly d Demanx Units	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH 240 MBH Code	Energy Rate S Value 3000 3000 3000 arameters Energy R	Units MBH MBH MBH quip eference umber	Seq Order Number 1 2 3	Switch over Control Entering	Hot Strg	Misc. Acc. 1 2 3		Lim
eat ef umbe	Equip Code r Name 2200E) 2200E) 2200E) 71	Num Of Un ST 1 ST 1 ST 1	its i	HW Pmp Full Ld Value 11.19 11.19 11.19 Hourl Deman Value	Units KW KW KW Hourly Demand Units TONS	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH 240 MBH Code	Energy Rate 3000 3000 3000 3000 arameters Energy R Type N CHILL-LD 1	Units MBH MBH MBH quip quip eference umber	Seq Order Number 1 2 3	Switch over Control Entering	Hot Strg	Misc. Acc. 1 2 3		Lim
eat ef umbe ase tili umbe	Equip Code Name 2200E) 2200E) 71	Num Of Un ST 1 ST 1 ST 1 ty ip PUMP H HT LOS	its i	HW Pmp Full Ld Value 11.19 11.19 11.19 Hourt Deman Value 39.1 612.2	Units KW KW KW Y Hourly d Demand Units TONS	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH Code FTSAMCLG FTSAMHTG	Energy Rate 3000 3000 3000 arameters Energy Type N CHILL-LD HOT-LD 1	Units MBH MBH MBH quip eference umber	Seq Order Number 1 2 3 Demand Limiting	Switch over Control Entering Temp	Hot Strg Leavi Temp	Misc. Acc. 1 2 3		Lim
eat ef umbe ase tili umbe	Equip Code Name 2200E) 2200E) 71	Num Of Un ST 1 ST 1 ST 1 ty ip PUMP H HT LOS	its i	HW Pmp Full Ld Value 11.19 11.19 11.19 Hourt Deman Value 39.1 612.2	Units KW KW KW Bas y Hourly d Demand Units TONS HBH	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH Code FTSAMCLG FTSAMHTG	Energy Rate 3000 3000 3000 3000 arameters Energy R Type N CHILL-LD 1	Units MBH MBH MBH quip eference umber	Seq Order Number 1 2 3 Demand Limiting	Switch over Control Entering Temp	Hot Strg Leavi Temp	Misc. Acc. 1 2 3		Lim
eat ef umbe ard lase tili	Equip Code r Name 2200EX 2200EX 71	Num Of Un ST 1 ST 1 ST 1 ty ip PUMP H HT LOS	its \	HW Pmp Full Ld Value 11.19 11.19 11.19 Hourl Deman Value 39.1 612.2	Units KW KW KW	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH Se Utility P d Schedule Code FTSAHCLG FTSAHHTG	Energy arameters Energy Type NCHILL-LD 1 HOT-LD 1	Units MBH MBH MBH quip eference umber	Seq Order Number 1 2 3 Demand Limiting Number	Switch over Control Entering Temp	Hot Strg Leavi Temp	Misc. Acc. 1 2 3		Lim
eat ef umbe ard lase tili	Equip Code Name 2200E) 2200E) 71	Num Of Un ST 1 ST 1 ST 1 ty ip PUMP H HT LOS	T LOS S	HW Pmp Full Ld Value 11.19 11.19 11.19 Hourl Deman Value 39.1 612.2	Units KW KW KW Bas y Hourly d Demand Units TONS HBH	Cap'y Value Unit 2240 MBH 2240 MBH 2240 MBH Se Utility P d Schedule Code FTSAHCLG FTSAHHTG	Energy arameters Energy R Type R CHILL-LD 1 HOT-LD 1	Units MBH MBH MBH quip eference umber Num	Seq Order Number 1 2 3 Demand Limiting Number	Switch over Control Entering Temp	Leavi Temp	Misc. Acc. 1 2 3		Lim

#1 Misc Equ							,		• • • • • • • • • • • • • • • • • • • •			
iisc Equ			F	Cabad	#2	F	F	0-1-4	#3			0.1.4
ef Cod		nergy alue	Energy Units		Equip Code	Energy Value		Sched	Equip	Energy Value		
		56	KW	Code	Code	value	Units	code	Code	value	Units	Code
		56	KW									
		56	KW									
		Equ	ipment S	ection A	Ulternative	#2	•••••					
	Elec	Consump	Elec D	Equipemand De		ption / To	00 Schedu	ules			and Limit	
iumber 2	Sche	dule	Schedu	le Ma	x KW Alter GAS E	native De				Schedule	Drift	
Load Ali	Coil Cods To E	ooling quipment dizing	-Group Begin	1Gro End Beg	oup 2Gro in End Beg	oup 3G	roup 4-	-Group	5Group	6Grou	up 7- -Gro	up 8Gr
Card 62 Cool Equi Ref Code	ip Nu		apacity- ue Unit	-COOL I NG	Cooling Energy alue Uni 663 MBH	·· ··	н	EAT RECO	VERY Energy Value l	,	Seq Order Seq	Demand

	Cooling			Energy	Energy			Number	Percent	Low Sp	d Low!	Spd	
wer	Tower	Capacit	y Capacity	Consump	Consump	Fluid	Tower	Of	Airflow	Energy	Energ	9 У	
ef	Code E95100	Value	Units	Value 29.84	Units KW	Type	Туре	Cells 2	Low Spd	Value	Unit	s	
		Ec	puipment Sect	ion Alter	native #3	;							
ard			no Elec Demo		•	ion / T00	Schedule	es			mand Lim		
l te			/ Time of t								Tempe		
iumbe		hedule	Schedule	•	/ Alterna	tive Desc	ription			Schedul		ift	
5						UAL SCREW		EXIST	BOILER				
ard	60				Cool	ing Load	Assignmer	nt					
	All Coil						-						
lsgn	Loads To	Equipmen	nt -Group 1	- Group	2Group	3Gro	up 40	Group 5-	-Group	6Gra	up 7	Group	8Gro
Ref	Cool Ref	Sizing	Begin En	d Begin E	nd Begin	End Begi	n End Be	egin End	Begin E	nd Begi	n End B	egin	End Begi
1	1	BLKPLAN	T 1 1										
Cool Ref	62Equip Code Name YSCRW22	Num - Of - Units V	C -Capacity alue Units 55 TONS	OOLING	nergy	Ca		RECOVE	RY Energy- lue Un	•••	Seq Order	Seq	Demand Limit Number
Cool Ref Num 1	Equip Code Name YSCRW22	Num - Of - Units V 1 5	C C -Capacity alue Units	OOLING E Value 355	nergy Units KW	Ca Valu	HEAT pacity we Units	F RECOVE	RY Energy- lue Ur	its	Seq Order Num	Seq	Limit
Cool Ref Num 1 Card	Equip Code Name YSCRW22 63CHILLE	Num - Of - Units V 1 5	CON	OOLING Value 355 Cooling	nergy Units KW Pumps an	Ca Valu d Reference REC or AU	pacity up Units ces	T RECOVE	RYRYEnergy-lue Ur	its	Seq Order Num	Seq	Limit
Cool Ref Num 1 Card Cool Ref	Equip Code Name YSCRW22 63CHILLE	Num - Of - Units V. 1 5:	CON ad Full Loa	OOLING Value 355 Cooling DENSER d Full Lo	Pumps and	a Valu d Referenc REC or AU Load Full	pacity pac	r RECOVE Va Va witch- ver	RYRYEnergy-lue Ur	its Cooling	Seq Order Num	Seq Type	Limit
Cool Ref Num 1 Card Cool Ref Num	Equip Code Name YSCRW22 63CHILLEI Full Load Value	Num - Of - Units V. 1 5: D WATER Full Lo Units	CON ad Full Loa Value	OOLING Value 355 Cooling DENSER d Full Lo	nergy Units KW Pumps an	a Valu d Referenc REC or AU Load Full	pacity pac	r RECOVE Va Va witch- ver	RYRYEnergy-lue Ur	its Cooling	Seq Order Num	Seq Type	Limit
Cool Ref Num 1 Card Cool Ref	Equip Code Name YSCRW22 63CHILLE	Num - Of - Units V. 1 5:	CON ad Full Loa	OOLING Value 355 Cooling DENSER d Full Lo	Pumps and	a Valu d Referenc REC or AU Load Full	pacity pac	r RECOVE Va Va witch- ver	RYRYEnergy-liue Ur	its Cooling	Seq Order Num	Seq Type	Limit
Cool Ref Num Card Cool Ref Num	Equip Code Name YSCRW22 63CHILLEI Full Load Value	Num - Of - Units V. 1 5: D WATER Full Lo Units	CON ad Full Loa Value	OOLING Value 355 Cooling DENSER d Full Lo	Pumps and	a Valu d Referenc REC or AU Load Full	pacity pac	r RECOVE Va Va witch- ver	RYRYEnergy-liue Ur	its Cooling	Seq Order Num	Seq Type	Limit
Cool Ref Num 1 Cool Ref Num	Equip Code Name YSCRW22 63CHILLEI Full Loed Value 74.6	Num - Of - Units V 1 5: D WATER Full Lo Units KW		OOLING Value 355 Cooling DENSER d Full Lo Units KW	Pumps and Pumps and Pumps and Value	 Ca Valu d Referenc REC or AU Load Full Unit	es Lapacity Lapacity Lapacity Lapacity	FRECOVE Va Va witch- ver ontrol	RYEnergy- lue Ur Cold	Cooling Tower	Seq Order Num Hisc. Access.	Seq Type	Limit
Cool Ref Num 1 Cool Ref Num 1	Equip Code Name YSCRW22 63CHILLEI Full Loed Value 74.6	Num - Of - Units V 1 5: D WATER Full Lo Units KW		OOLING Value 355 Cooling DENSER d Full Lo Units KW	Pumps annHT ad Full l Value	 Ca Valu d Referenc REC or AU Load Full Unit	pacity ue Units ces IX Si Load o	r RECOVE Va Witch- ver ontrol	RY	Cooling Tower	Seq Order Num Hisc. Access.	Seq Type	Limit
Cool Ref Num 1 Card Cool Ref Num 1	Equip Code Name YSCRW22 63CHILLEI Full Load Value 74.6	Num - Of - Units V. 1 5: D WATER Full Lo Units KW	CON ad Full Loa Value 37.3	OOLING Value 355 Cooling DENSER d Full Lo Units KW	Pumps and Pumps and Pumps and Value	 Ca Valu d Referenc REC or AU Load Full Unit	pacity Pe Units Pes Pes Units Pes Pes Color	r RECOVE Va witch- ver control	RYEnergy- lue Ur Cold Storage	Cooling Tower	Seq Order Num Misc. Access.	Seq	Limit
Cool Ref Num 1 Cool Ref Num 1	Equip Code Name YSCRW22 63CHILLEI Full Load Value 74.6	Num - Of - Units V. 1 5: D WATER Full Lo Units KW		OOLING Value 355 Cooling DENSER d Full Lo Units KW Bas Hourly	Pumps and Pumps and Pumps and Value	 Ca Valu d Referenc REC or AU Load Full Unit	pacity Pe Units Pes Pes Units Pes Pes Color	r RECOVE Va Witch- ver ontrol Deence Li	RYEnergy- lue Ur Cold Storage	Cooling Tower	Seq Order Num Misc. Access.	Seq	Limit

	Cooling			Condenser Energy	/ Coolin Energy	g Tower Pa	arameters				Low Spd	
ower	Tower	Capacity	Capacity			Fluid	Tower			Energy	•	
ef	Code EQ5100	Value	Units	Value 29.84	Units KW	Туре	Type		Low Spd		Units	
erd :	59 El native Ti	ec Consump	Elec Demar Time of Da	Equipment nd Demand ay Limit	Descript Alterna		Schedule	es			and Limit Temperatur Drift	-
	60				Cool	ing Load /	Nssignmer	nt			•••••	•••••
	All Coil Loads To		-Group 1-	-Grown 2-	-Grovin	3Gra	m 41	troup 5-	-Group /	6Cross	p 7Group	9Cpo
e f											P /Group End Begin	
		BLKPLANT						•			2	
ard	62			Co	oling Eq	uipment Pa	arameter:				•••••	
			co						γ		Seq	Demand
			apacity		rgy	Ca	pacity	•••	-Energy-	•••	Order Seq	Limit
um	Name	Units Valu		Value	Units	Valu	e Units	Va	ue Un	its	Num Type	Number
	VCENT47/	4 255										
	YCENT134	1 555	TONS	322	KW						1,,,0	
						l Deferenc	DC					
ard	63			- Cooling F	tumps and					•••••		
ard ool	63	WATER		- Cooling P	'umps and	REC or AU	x s	vitch-		Cooling	····	
ard ool ef um	63 CKILLED Full Load Value	WATER Full Load Units	CON DI	- Cooling P	'umps and	REC or AU oad Full	X Si Load or	witch- ver (Cooling	····	
ard ool ef	63 CHILLED Full Load	WATER	CONDI	- Cooling F ENSER Full Load	oumps and	REC or AU oad Full	X Si Load or	witch- ver (Cold Storage	Cooling	Misc.	
ard ool ef	63 CKILLED Full Load Value	WATER Full Load Units	CONDI Full Load Value	- Cooling F ENSER Full Load Units	oumps and	REC or AU oad Full	X Si Load or	witch- ver (Cold Storage	Cooling Tower	Misc.	
Card Cool Lef Lum	63 CHILLED Full Load Value 74.6	WATER Full Load Units KW	CONDI Full Load Value 37.3	- Cooling F ENSER Full Load Units KW	Pumps and HT I Fult L Value	REC or AU oad Full Unit	Constant	witch- ver (ontrol (Cold :	Cooling Tower	Misc. Access.	
Card Cool lef lum Card	63FUILLED FUIL LOAD Value 74.6	WATER Full Load Units KW	CONDI Full Load Value 37.3	- Cooling F ENSER Full Load Units KW Base Hourly	Cumps andHT Full L Value Utility	REC or AU oad Full Unit	Load of s C	witch- ver (ontrol (Cold Storage	Cooling Tower 1	Misc. Access.	
Card Cool Lef Lum Card Card	63Full Load Value 74.6 71 Base	WATER Full Load Units KW	Full Load Value 37.3 Hourly Demand	- Cooling F EMSER Full Lose Units KW Base Hourly Demand	Cumps andHT Full L Value Utility	REC or AU oad Full Unit: Parameter	Load of S C	ver (ontrol (Der	Cold Storage mand miting E	Cooling Tower 1	Misc. Access.	
Card Cool Ref Hum I Card Gase Utili	63Full Load Value 74.6 71 Base ty Utility	WATER Full Load Units KW	Full Load Value 37.3 Hourly Demand Value	- Cooling F EMSER Full Lose Units KW Base Hourly Demand	Pumps andHT Fult L Value Utility Schedule	REC or AU oad Full Unit	Load of s C	ver (ontrol (Der	Cold Storage mand miting E	Cooling Tower 1	Misc. Access.	
Card Cool Ref Num I Card Base	63Full Load Value 74.6 71 Base ty Utility	WATER Full Load Units KW	Full Load Value 37.3 Hourly Demand Value	- Cooling F ENSER Full Lose Units KW Base Hourly Demand Units	Pumps andHT Fult L Value Utility Schedule	REC or AU. oad Full Unit: Parameter: Energy Type	Load of s C	ver (ontrol (Der	Cold Storage mand miting E	Cooling Tower 1	Misc. Access.	
Card cool def dum Card case Itili	63 Full Load Value 74.6 71 Base ty Utility PIPE-F	WATER Full Load Units KW	Full Load Value 37.3 Hourly Demand Value 39.1	- Cooling F ENSER Full Lose Units KW Base Hourly Demand Units TONS	Pumps andHT Full L Value Utility Schedule Code FTSAMCLO	REC or AU. oad Full Unit: Parameter: Energy Type CHILL-L	x Si Load of s Ci S Equip Refer Numbe	ver (pontrol (Derence Lin	Storage Storag	Cooling Tower 1	Misc. Access. Leaving Temp	
ard dool ef um ard dase tili	63	WATER Full Load Units KW	Full Load Value 37.3 Hourly Demand Value	- Cooling FENSER Full Lose Units KW Base Hourly Demand Units TONS	Pumps andHT Fult L Value Utility Schedule Code FTSAMCLO	REC or AU. oad Full Unit: Parameter: Energy Type CHILL-L	x Si Load of s Ci S Equip Refer Numbe	witch- ver (pontrol (Dec ence Lin r Num	Cold Storage mand miting E	Cooling Tower 1	Misc. Access. Leaving Temp	
Card cool def dum Card case Itili	63	D WATER Full Load Units KW	Full Load Value 37.3 Hourly Demand Value 39.1	- Cooling FENSER Full Lose Units KW Base Hourly Demand Units TONS Condenser	Pumps andHT Full L Value Utility Schedule Code FTSAMCLO	REC or AU. oad Full Unit: Parameter: Energy Type GHILL-L	x Si Load of s Ci S Equip Refer Numbe	pitch- ver (pontrol (pon	Cold Storage S	Cooling Tower 1	Misc. Access. Leaving Temp	

Utility Description Reference Table -----

Schedules:

FSHBARRL F.S.H. BARRACKS LIGHT/MISC. SCHEDULE FSHBARRP F.S.H. BARRACKS PEOPLE SCHEDULE FSHDINL F.S.H. DINING LIGHTING/MISC. LOAD SCHED. FSHDINP F.S.H. DINING PEOPLE SCHEDULE FSHOFFIC F.S.H. OFFICE INTERNAL LOAD SCHEDULE FTSAMCLG EEAP BOILER/CHILLER STUDY FTSAMHTG EEAP BOILER/CHILLER STUDY

System:

SZ SINGLE ZONE

Equipment:

Cooling:

EQ1001L 2-STG CENTRIFUGAL CHILLER >550 TONS YCENT134 YORK CENT. R-134A CHILL YENGORIV YORK ENGINE DRIVEN CHILLER YSCRW22 YORK W.C. SCREW CHILL.

Heating:

2200EXST EXISTING NAT. DRAFT AJAX HWH BOILER

Tower:

EQ5100 COOLING TOWER FANS

Misc:

EQ5013 WATER CIRCULATING PUMP - CONSTANT VOLUME

Card 39- System Alternative Number Description

```
EXISTING SYSTEM
Card 40----- System Type -----
                           -----OPTIONAL VENTILATION SYSTEM-----
                             Ventil
Set System Deck Cooling Heating Cooling Heating Static
Number Type Location SADBVh SADBVh Schedule Schedule Pressure
1 SZ
Card 41----- Zone Assignment ------
System
                    Ref #1
                                                Ref #2 Ref #3
Set
                                                                                                           Ref #4
                                                                                                                                         Ref #5
                                                                                                                                                                       Ref #6
Number
                   Begin End
                                                 Begin End Begin End Begin End Begin End
1
                 5 40
Card 42----- Fan SP and Duct Parameters-----
System Cool Heat Return Mn Exh Aux Rm Exh Cool Return Supply Supply Return
Set Fan Fan Fan Fan Fan Fan Fan Har Fan Har Duct Duct Air
Number SP SP SP SP SP SP Loc Loc Ht Gn Loc Path
1 2 2
Card 45----- Equipment Schedules -----
System Main Direct Indirect Auxiliary Main Main Auxiliary
Set Cooling Evap Evap Cooling Heating Preheat Reheat Mech. Heating
Number Coil Economizer Coil Coil Coil Coil Mumidity Coil
                                                                                                                                                                Auxiliary
1 FTSAMCLG
                                                                                                FISAMHIG FISAMHIG FISAMHIG
----- Equipment Section Alternative #1 -----
Card 59----- Equipment Description / TOD Schedules -----
              Elec Consump Elec Demand Demand
                                                                               ---- Demand Limit ---
Alternative Time of Day Time of Day Limit
                                                                                                                                                            Temperature
Number Schedule Schedule Max KW Alternative Description Schedule Drift
1
                                                                            BASE CASE
Card 60----- Cooling Load Assignment----
Load All Coil Cooling
Asgn Loads To Equipment -Group 1- -Group 2- -Group 3- -Group 4- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-
Ref Cool Ref Sizing Begin End Begin
```

ool I	quip	Num		С	OOLING			HEAT REC	OVERY		Seq		Deman	ď
ef (Code	Of	Cap	pacity	Er	жгду	Capaci	y	Energ	y	Order	Seq	Limit	
.m 1	ame	Units	Value	e Units	Value	Units	Value Ur	nîts	Value I	Units	Num	Type	Numbe	r
1	Q1001L	1	657	TONS	595	KW								
							References C or AUX			•••••		•		
							ed Full Load		Cold	Cooling	Misc.	_		
	/alue	Units		Value	Units	Value	Units		l Storage	•	Acces			
	74.6	KW		37.3	KW			25		1	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
ad		l Coil					Load Assign						 3Gr	
_							Begin End							
	1			1	JUJ 111 21 12	ocym cha	ocgiii cia	begin ti	o begin c	begin	LIKE (begint Li	M Deg	,,,,
ed :	67					Westing (Equipment De	namatana						
at	67 Equip Code		mber	HW Pmp Full Ld		Heating (Cap'y	Equipment Pa Energy Rate		Seq Order	Switch over	Hot	Misc.		
eat	Equip	Nur Of	mber	HW Pmp Full Ld			Energy Rate		Seq	Switch over	Hot	Misc.	Cogen	Lin
eat ef	Equip Code	Nur Of Un	mber its	HW Pmp Full Ld Value	Units	Cap'y	Energy Rate		Seq Order	Switch over	Hot	Misc.		Den Lin Nun
eat of umbe	Equip Code r Name	Nur Of Uni	mber its	HW Pmp Full Ld Value 11.19	Units :	Cap'y Value Unite	Energy Rate Value	Units	Seq Order Number	Switch over	Hot	Misc.		Lin
eat ef umbe	Equip Code r Name 2200EX	Nur Of Uni ST 1	mber its	HW Pmp Full Ld Value 11.19 11.19	Units KW	Cap'y Value Unit: 2240 MBH	Energy Rate Value 3000	Units M8H	Seq Order Number 1	Switch over	Hot	Misc. Acc.		Lin
eat ef ambe	Equip Code r Name 2200EX 2200EX	Nur Of Un ST 1 ST 1	its	HW Pmp Full Ld Value 11.19 11.19	Units :	Cap'y Value Unit: 2240 MBH 2240 MBH 2240 MBH	Energy Rate Value 3000 3000	Units MBH MBH MBH	Seq Order Number 1 2 3	Switch over Control	Hot Strg	Misc. Acc. 1 2 3		Lin
eat ef imbe	Equip Code r Name 2200EX 2200EX	Nur Of Un ST 1 ST 1	its	HW Pmp Full Ld Value 11.19 11.19 11.19	Units KW KW KW KW KW KW Bas	Cap'y Value Unit: 2240 MBH 2240 MBH 2240 MBH	Energy Rate S Value 3000 3000 3000	Units M8H MBH MBH	Seq Order Number 1 2 3	Switch over Control	Hot Strg	Misc. Acc. 1 2 3		Lim
eat ef ambe	Equip Code r Name 2200EX 2200EX 2200EX	Nur Of Uni ST 1 ST 1	its	HW Pmp Full Ld Value 11.19 11.19	Units KW KW KW Bas	Cap'y Value Unit: 2240 MBH 2240 MBH 2240 MBH	Energy Rate S Value 3000 3000 3000	Units M8H MBH MBH	Seq Order Number 1 2 3	Switch over Control	Hot Strg	Hisc. Acc. 1 2 3		Lin
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eat ef umbe	Equip Code r Wame 2200EX 2200EX 2200EX 71 Base ty Utili r Descr	Nur Of Un ST 1 ST 1	mber its	HW Pmp Full Ld Value 11.19 11.19 11.19	Units KW KW KW Bas Grand	Cap'y Value Unit: 2240 MBH 2240 MBH 2240 MBH 2240 MBH COde	Energy Rate 3000 3000 3000 3000 arameters Energy R Type N	Units M8H M8H M8H quip quip eference	Seq Order Number 1 2 3	Switch over Control	Hot Strg	Hisc. Acc. 1 2 3		Lin
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	Savio	Energy	Engage	Cabad	#2 5===i==	F	r	A-1-4	#3	_	_	
Ref	Code	Energy Value	Energy Units	Code	Equip Code	Energy Value	Energy		Equip	Energy	Energy	
1	E95013	.56	KW	2006	Louie	Value	Units	Loge	Code	Value	Units	Code
2	EQ5013	.56	KW									
3	EQ5013	.56	KW									
••••		· E	quipment S	ection A	lternative	#2	•••••	•••••				
	E native T	lec Consu	mp Elec D	emand Dec f Day Lis	mand mit x KW Alte	rnative De	escription	1		Demar		••
						CENTRESIC		D-MED F	VICT DIO			
					w.c.	CENTRIFUG	AL CHILLE	R-VFD, E	XIST BLR			
				•••••								
Load	All Coil	Cooling			с	ooling Loa	ad Assigna	nent				
Load Asgn	All Coil Loads To	Cooling Equipmen	nt -Group	1Gro	c up 2Gr	ooling Loa	ed Assigna	nent	Group	6Group	7Grou	ıp8- ⋅
Load Asgn Ref	All Coil Loads To	Cooling	nt -Group Begin	1Gro	c up 2Gr	ooling Loa	ed Assigna	nent	Group		7Grou	ıp8- ⋅
Load Asgn Ref 1	All Coil Loads To Cool Ref 1	Cooling Equipment Sizing BLKPLAN	nt -Group Begin T 1	1Grod End Begin	Cup 2Gr n End Beg Cooling	ooling Loa oup 3G in End Be Equipment	ed Assignm Group 4- egin End t Paramete	ent -Group 5 Begin En	Group d Begin E	6Group End Begin E	7Grou	up 8- in End i
Load Asgn Ref 1	All Coil Loads To Cool Ref 1	Cooling Equipment Sizing BLKPLAN	nt -Group Begin T 1	1 Grod End Begin 1	up 2Gr n End Beg Cooling	ooling Loa oup 3G in End Be Equipment	od Assignm Group 4- egin End : Parameto	-Group 5 Begin En	Group d Begin E	6Group End Begin E	7Grou	up 8-
Load Asgn Ref 1 Card Cool	All Coil Loads To Cool Ref 1 62 Equip Code	Cooling Equipment Sizing BLKPLAN Num - Of - Units V	nt -Group Begin T 1	1Grov End Begin 1 -COOLINGs Va	up 2Gr n End Beg Cooling Energy lue Uni	ooling Loa oup 30 in End Be Equipment	ed Assignm Group 4- egin End t Paramete	-Group 5 Begin En	Group d Begin E ERYEnergy-	6Group End Begin E	7Grou End Begin eq eq rder Seq	up 8- in End i
Load Asgn Ref J Cool Ref	All Coil Loads To Cool Ref 1 62 Equip Code Name YCENVFD	Cooling Equipmer Sizing BLKPLAN	nt -Group Begin T 1 -Capacity- alue Unit 55 TONS	1Grow End Begin 1 	up 2Gr n End Beg Cooling Energy lue Uni 2 KW	equipment	od Assignm Group 4- egin End Paramete Capacity- slue Unit	-Group 5 Begin En	Group d Begin E ERYEnergy- alue Ur	6Group End Begin E	7Grou End Begin eq eq rder Seq	up 8- in End I
Load Asgn Ref 1 Card Cool Ref Num 1	All Coil Loads To Cool Ref 1 62 Equip Code Name YCENVFD 63 CHILLEI	Cooling Equipmer Sizing BLKPLAN Num - Of - Units V.	nt -Group Begin T 1	1Grow End Begin 1	up 2Gr n End Beg CoolingEnergy lue Uni 2 KW	epuipment Equipment ts Va	ernces	-Group 5 Begin EnAT RECOV	Group d Begin E ERYEnergy- alue Ur	6Group End Begin E	7Grou End Begin eq eq rder Seq	up 8- in End I
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Load Asgn Ref 1 Card Cool Ref Num 1	All Coil Loads To Cool Ref 1 62 Equip Code Name YCENVFD 63 CHILLEI	Cooling Equipmer Sizing BLKPLAN Num - Of - Units V.	nt -Group Begin T 1	1Grow End Begin 1	up 2Gr n End Beg CoolingEnergy lue Uni 2 KW	epoling Loadoup 3	ernces	-Group 5 Begin En AT RECOV Switch	Group d Begin E ERYEnergy- alue Ur	6Group End Begin E Se On nits No	7Grou	up 8- in End I

				001100	1 / 600011	g lower	Parameters	3						
	Cooling			Energy	Energy			Number	Percent	Low S	pd L	.ow Spd		
Tower				Consump	•	Fluid	Tower	Of	Airflow	Energ	y E	nergy		
	Code	Value	Units	Value	Units	Type	Type		Low Spd	Value	t	Inits		
1	EQ5100			29.84	KW			2						
•••••	•••••	Equi	pment Sec	ction Alte	rnative #3			••••						
Card 59				Equipmen		ion / TO	00 Schedul	es •••••	•••••					
41.				nand Deman						D		Limit -		
				Day Limit								mperatu	ге	
Number 3	Sch	edule	Schedule	e Max K	W Alterna EXIST (scription NATURAL D	RAFT HIG	H BLR	Schedu	le	Drift		
-	ment Load nce Heat			-Group 2- Begin End	-Group : Begin Er									
1	1 7 Equip Code	Number Of Units				g Equipme ! ! its !	ent Parame Energy Rate	ters its H	Seq S	witch over	 Hot	Misc.		Demand Limit Number
Card 67 Heat Ref Number 1 2 Card 7	Tequip Code Name BOILHEFT BOILHEFT	Number of Units 1	HW Pmp Full Ld Value 5.6	Units KW Bas y Hourly d Demand Units	Cap'y Value Un 1830 MBI 915 MBI se Utility d Schedule Code	g Equipmo	ent Parame Energy Rate Value Un 2000 MB 1000 MB ers Equip y Refer Numbe	its H H Deence Li	Seq S Order o Number C 1 2	switch over control	Hot Strg	Misc. Acc. 1		Demand Limit
Card 67 Ref Number 1 Card 7 Base Utility Number 1	Equip Code Name BOILHEFT BOILHEFT Base y Utility Descrip PIPE HT	Number Of Units 1 1	HW Pmp Full Ld Value 5.6 Hourl Deman Value 612.2	Units KW Bas y Hourly d Demand Units MBH	Cap'y Value Un 1830 MBI 915 MBI GE Utility d Schedul Code FTSAMHT	g Equipmon (ent Parame Energy Rate Value Un 2000 MB 1000 MB ers Equip y Refer Numbe	its H H Deence Li	Seq S Order o Number of 1 2 mand miting E mber 1	switch over control control	Hot Strg Lea Temp	Misc. Acc. 1		Demand Limit
Card 67 Heat Ref Number 1 Card 7 Base Utility Number 1	Equip Code Name BOILHEFT BOILHEFT Base y Utility Descrip PIPE HT	Number of Units 1 1	HW Pmp Full Ld Value 5.6 Hourl Deman Value 612.2	Units KW	Cap'y Value Un 1830 MBI 915 MBI GE Utility d Schedule Code FTSAMHTO	g Equipmon () () () () () () () () () (ent Parame Energy Rate Value Un 2000 MB 1000 MB ers Equip y Refer Numbe D 1	its H H Deence Li	Seq S Order of Number of 1 2 mand miting E mber 1	switch over control intering emp	Hot Strg Lea' Temp	Misc. Acc. 1	Cogen	Demand Limit
Card 67 Heat Ref Number 1 Card 7 Base Utility Number 1 Card 7 Hisc	Equip Code Name BOILHEFT BOILHEFT Base y Utility PIPE HT	Number Of Units 1 1	HW Pmp Full Ld Value 5.6 Hourl Deman Value 612.2	Units KW	Cap'y Value Un 1830 MBI 915 MBI GE Utility Code FTSAMHTG	g Equipmon (ent Parame Energy Rate Value Un 2000 MB 1000 MB ers Equip y Refer Numbe D 1 ccessory -	its H H Deence Li	Seq S Order o Number of 1 2 mand miting E mber 1	switch over control control	Hot Strg Lea Temp	Misc. Acc. 1	Cogen	Demand Limit

03018504 EEAP BOILER-CHILLER STUDY FT. SAM HOUSTON - SAN ANTONIO, TX. CORPS OF ENGINEERS - FORT WORTH, TEXAS HUITT - ZOLLARS INC. AREA 2200

Weather File Code:

Location:	SAN AN	TONIO, TE	ΧA
Latitude:	29.0	(deg)	
Longitude:	98.0	(deg)	
Time Zone:	6		
Elevation:	792	(ft)	
Barometric Pressure:	29.0	(in. Hg)	

Summer Clearness Number: 0.90
Winter Clearness Number: 0.90
Summer Design Dry Bulb: 97 (F)
Summer Design Wet Bulb: 76 (F)
Winter Design Dry Bulb: 30 (F)
Summer Ground Relectance: 0.20
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)
Air Specific Heat: 0.2444 (Btu/lbm/F)
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: June To November
System Simulation Period: January To December
Cooling Load Methodology: TETD/Time Averaging

Time/Date Program was Run: 19: 5: 7 6/ 8/95
Dataset Name: FSH2200 .TM

EM TOTALS LOAD PROFILE - ALTERNATIVE 1

SYSTEM LOAD PROFILE -----

System Totals

Percent	Cool	ing Loa	d	Heatir	ng Load	
Design	Cap.	Hours	Hours	Capacity	Hours	Hours
Load	(Ton)	(%)		(Btuh)	(%)	
0 - 5	32.2	7	279	-213,687	50	1,134
5 - 10	64.4	5	211	-427,375	14	307
10 - 15	96.7	6	235	-641,062	4	82
15 - 20	128.9	9	367	-854,749	7	168
20 - 25	161.1	8	349	-1,068,437	16	363
25 - 30	193.3	7	281	-1,282,124	3	78
30 - 35	225.6	8	324	-1,495,811	2	46
35 - 40	257.8	7	286	-1,709,499	2	49
40 - 45	290.0	5	223	-1,923,186	1	21
45 - 50	322.2	9	358	-2,136,873	1	15
50 - 55	354.5	8	318	-2,350,561	0	0
55 - 60	386.7	9	366	-2,564,248	0	0
60 - 65	418.9	5	204	-2,777,936	0	0
£" - 70	451.1	6	253	-2,991,623	0	0
75	483.3	1	43	-3,205,311	0	0
75 - 80	515.6	5	66	-3,418,998	0	0
80 - 85	547.8	0	0	-3,632,685	0	0
85 - 90	580.0	0	0	-3,846,373	ō	0
90 - 95	612.2	0	0	-4,060,060	0	0
95 - 100	644.5	0	0	-4,273,747	0	0
Hours Off	0.0	0	4,597	0	0	6,497

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 BASE CASE

•	Equip					Mon	thly Con	sumption						
1	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,25
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452
	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD													
	OIL	0	0	0	0	0	ō	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD													
	P STEAM	0	0	0	0	0	0	ō	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	ō	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
			BASE	UTILITY	,									
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,6
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39
				UTILITY										
	HOTLD	4555	4114	4555	4408	0	0	0	0	0	0	4408	4555	26,5
	PK	6.1	6.1	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	6.1	6.1	6
	EQ1001L					CHILLER	>550 TON	s						
	ELEC	0	0	0	0	151580			211763	166768	86289	0	0	994,1
	PK	0.0	0.0	0.0	0.0	481.0	522.3	568.8	596.6	535.0	368.3	0.0	0.0	596
	EQ5100			ING TOWE										
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	11898	0	0	121,4
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

BASE CASE

• • •	•••••	*******	•••••	E 6	UIP	MENT	ENE	RGY	CONS	UMPT	I O N	•••••	•••••	••••••
ef	Equip					Mon	thly Con	sumption						
JM.	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5100		COOL	ING TOWE	R FANS									
	WATER	0	0	0	0	699	804	952	980	757	378	0	0	4,569
	PK	0.0	0.0	0.0	0.0	2.3	2.4	2.6	2.6	2.5	1.9	0.0	0.0	2.6
1	EQ5001		CHIL	LED WATE	R PUMP	- CONST.	ANT VOLU	ME						
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	329,433
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5010		COND	ENSER WA	TER PUM	P-CV(HIG	H EFFIC.)						
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	164,717
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	О	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
ı			EXIS	TING NAT	. DRAFT	AJAX HW	H BOILER							
	GAS	10454	10246	6486	5991	0	0	0	0	0	0	6240	9940	49,358
	PK	30.0	30.0	10.9	9.3	0.0	0.0	0.0	0.0	0.0	0.0	10.4	30.0	30.0
1	E95013		WATE	R CIRCUL	ATING P	UMP - CO	NSTANT V	OLUME						
	ELEC	8325	7520	8325	8057	0	0	0	0	0	0	8057	8325	48,609
	PK	11.2	11.2	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.2
1	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
ı	EQ5013		WATE	R CIRCUL	ATING P	UMP - CO	NSTANT V	OLUME						
	ELEC	417	376	417	403	0	0	0	0	0	0	403	417	2,433
	PK	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6
2			EXIS	TING NAT	. DRAFT	AJAX HW	H BOILER							
	GAS	17	91	0	0	0	0	0	0	0	0	0	19	127
	PK	2.4	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	5.1
2	EQ5013			R CIRCUL	ATING P	UMP - CO	NSTANT V	OLUME						
	ELEC	134	269	0	0	0	0	0	0	0	0	0	67	470
	PK	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2
2	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	2	3	0	0	0	0	0	0	0	0	0	1	5
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 BASE CASE

lef	Equip			• • • • • • • • • • • • • • • • • • • •		Mont	hly Cons	umption ·		• • • • • • •				
lum	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2	EQ5013	••	WATE	R CIRCUL	ATING PU	MP - CON	STANT VO	LUME						
	ELEC	7	13	0	0	0	0	0	0	0	0	0	3	24
	PK	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6
3			EXIS	TING NAT	. DRAFT	AJAX HWH	BOILER							
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	Ĺo
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ5013		WATE	R CIRCUL	ATING PU	MP - CON	STANT VO	LUME						
	ELEC	0	0	0	0	0	0	0	0	0	o	0	Ō	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
GAS ENGINE DRIVEN CHILLER, EXISTING BLR

•••	**********			E (UIPI	KENT	ENEI	RGY	ONS	JMPTI	ON			
ef	Equip	•••••				Mont	thly Cons	sumption						
lum	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,251
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	٥	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BAS	E UTILIT	Υ									
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,666
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39.1
1			YOR	K ENGINE	DRIVEN	CHILLER								-
	GAS	0	0	0	0	9807	11472	13818	14498	11113	5068	0	0	65,775
	PK	0.0	0.0	0.0	0.0	33.9	34.6	36.2	36.6	35.3	24.9	0.0	0.0	36.6
1	E95100		coc	LING TOW	ER FANS									-
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	11600	0	0	121,172
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	E 9 5100		coc	LING TO	ER FANS									
	WATER	0	0	0	0	736	851	1013	1046	803	390	0	0	4,840
	PK	0.0	0.0	0.0	0.0	2.4	2.4	2.4	2.4	2.4	2.0	0.0	0.0	2.4

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 GAS ENGINE DRIVEN CHILLER, EXISTING BLR

				E Q	UIP	ENT	ENE	RGY (CONSI	UMPT	1 O N		•••••	
Ref	Equip					Mon	thly Con	sumption						
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E95001		CHIL	LED WATER	R PUMP -	CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	329,433
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5011		COND	ENSER WAT	TER PUM	P-CV(MED	IUM EFFI	C.)						
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	164,717
•	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300		CONT	ROL PANE	L & INTE	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
W. C. DUAL SCREW CHILLER, EXIST BOILER

ef	Equip					Mon	thly Con:	sumption			• • • • • • • •			
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,25
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.
1	MISC LD													
	ELEC	0	0	0	O	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
2	MISC LD													
	GAS	0	0	Đ	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
3	MISC LD													
	01L	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1				E UTILIT										
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,6
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39
1	YSCRW22			K W.C. S										
	ELEC	0	0	0	0	94351	109968	131558	137516	106569	51609	0	0	631,5
	PK	0.0	0.0	0.0	0.0	338.4	343.0	352.2	355.0	347.1	264.5	0.0	0.0	355
1	E95100			LING TOW										
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	12459	0	0	122,0
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29
1	E95100			LING TOW										
	WATER	0	0	0	0	647	746	886	912	702	346	0	0	4,2
	PK	0.0	0.0	0.0	0.0	2.1	2.1	2.1	2.1	2.1	1.8	0.0	0.0	2

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3 W. C. DUAL SCREW CHILLER, EXIST BOILER

••••				E Q	UIPI	HENT	ENE	RGY (ONS	J H P T	O N	•••••	•••••	••••••
Ref	Equip					Mon	thly Con	sumption			· · · · · · · · · · · · · · · · · · ·		•••••	
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001		CHIL	LED WATER	PUMP	- CONST.	ANT VOLU	ME						
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	329,433
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5011		COND	ENSER WAT	TER PUM	P-CV(MED	IUM EFFI	c.)						
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	164,717
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	E95300		CONT	ROL PANEI	& INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4 W.C. CENTRIFUGAL CHILLER, EXISTING BOILR

ef	Equip ·		•••••	• • • • • • • •	• • • • • • • •	···· Mon	thly Con	sumption			• • • • • • • • •	• • • • • • • •	• • • • • • • • • • • • • • • • • • • •	
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	0ct	Nov	Dec	Tota
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,25
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
5	MISC LD													
	P HOTHZO	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1				E UTILIT										
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,60
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39
١					R-134A C									
	ELEC	0	0	0	0	92599	106789	126901	132023	103005	50227	0	0	611,5
	PK	0.0	0.0	0.0	0.0	306.9	311.1	319.4	322.0	314.8	240.0	0.0	0.0	322
١	E95100			LING TON			_,							
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	12467	0	0	122,0
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29
ļ	E95100			LING TOW										
	WATER	0	0	0	0	645	743	882	907	699	345	0	0	4,2
	PK	0.0	0.0	0.0	0.0	2.1	2.1	2.1	2.1	2.1	1.8	0.0	0.0	2

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4 W.C. CENTRIFUGAL CHILLER, EXISTING BOILR

				E Q	UIPI	HENT	ENE	RGY (O N S 1	инрт 1	ON			
ef	Equip					Mon	thly Con	sumption						
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001		CHIL	LED WATER	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	O	0	0	55502	53712	55502	55502	53712	55502	0	0	329,433
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	E95011		COND	ENSER WAT	TER PUN	P-CV(MED	IUM EFFI	c.)						
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	164,717
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300		CONT	ROL PANEI	L & INT	ERLOCKS								
	ELEC	ō	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 W.C. CENTRIFUGAL CHILLER-VFD, EXIST BLR

ef	Equip	***********				Mont	hly Con	sumption						
.m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,251
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	1
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1				E UTILIT										
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,66
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39.
1	YCENVFD			K TURBO										,
	ELEC	0	0	0	0	82189		117375	123391	93614	41497	0	0	554,84
	PK	0.0	0.0	0.0	0.0	297.8	304.5	317.9	322.0	310.5	216.8	0.0	0.0	322.
ß	E95100			LING TOW										
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	12289	0	0	121,86
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.
1	E95100			LING TO										
	WATER	0	0	0	0	636	734	873	899	690	337	0	0	4,10
	PK	0.0	0.0	0.0	0.0	2.0	2.1	2.1	2.1	2.1	1.8	0.0	0.0	2.

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 W.C. CENTRIFUGAL CHILLER-VFD, EXIST BLR

				E Q	UIPI	HENT	ENE	RGY	CONSI	J M P T	I O N	••••••		••••••
Ref	Equip				• • • • • • •	Mon	thly Con	sumption						
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E95001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	329,433
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5011		COND	ENSER WA	TER PUMI	P-CV(MED	IUM EFFI	c.)						
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	164,717
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300		CONT	ROL PANE	L & INTI	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
EXIST CHILLER, NATURAL DRAFT HIGH X BLR

e f	Equip		• • • • • • • •			Hon	thly Cons	sumption						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	0ct	Nov	Dec	Tota
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,25
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	O	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1			BAS	E UTILIT	1									
	HOTLD	4555	4114	4555	4408	0	0	0	0	0	0	4408	4555	26,59
	PK	6.1	6.1	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	6.1	6.1	6.
1				H EFFICII	NCY MOD	ULAR FIR	ETUBE BO	IL.						
	GAS	8361	8169	5293	4889	0	0	0	0	0	0	5092	8030	39,83
	PK	20.0	20.0	8.9	7.6	0.0	0.0	0.0	0.0	0.0	0.0	8.5	20.0	20.
1	E95020			TING WAT										+
	ELEC	4166	3763	4166	4032	0	0	0	0	0	0	4032	4166	24,32
	PK	5.6	5.6	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	5.
1	EQ5311			LER CONT										
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	54
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3 EXIST CHILLER, NATURAL DRAFT HIGH % BLR

f Equip					Mont	hly Cons	umption ·			• • • • • • • • • • • • • • • • • • • •			
m Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1 EQ5020		HEAT	ING WATE	R CIRCUL	ATION PU	MP							
ELEC	2775	2507	2775	2686	0	0	0	0	0	0	2686	2775	16,203
PK	3.7	3.7	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	3.7
2		HIGH	EFFICIE	NCY MODU	LAR FIRE	TUBE BOI	ι.						
GAS	189	269	0	0	0	0	0	0	0	0	0	97	555
PK	6.7	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	8.6
2 Eq5020		HEAT	ING WATE	R CIRCUL	ATION PU	IMP							
ELEC	1	1	0	0	0	0	0	0	0	0	0	1	3
PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 EQ5311		BOIL	ER CONTR	OLS									
ELEC	7	7	0	0	0	0	0	0	0	0	0	4	19
PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

01 Card - Job Information

Project: 030185.04 EEAP BOILER-CHILLER STUDY Location: FT. SAM HOUSTON - SAN ANTONIO, TX. Client: CORPS OF ENGINEERS - FORT WORTH, TEXAS

Program User: HUITT - ZOLLARS INC.

Comments: QUADANGLE AREA

Card O8----- Climatic Information -----Summer Winter Summer Summer Winter Summer Winter Design Design Building Ground Ground Weather Clearness Clearness Design Code Number Number Dry Bulb Wet Bulb Dry Bulb Orientation Reflect Reflect SANANTON

----- Load Section Alternative #1 -----

Card 19- Load Alternative -Number Description

1

20

78

QUADRANGLE LOAD DESCRIPTION

78

50

Card 20----- General Room Parameters -----Zone Acoustic Floor to Duplicate Duplicate Perimeter Reference Room Room Floor Floor Const Plenum Ceiling Floor Floors Rooms per Depth Number Number Descrip Length Width Type Height Resistance Height Multiplier Zone

181 5 5 BLDG T56 45 3 3 2.54 15

BLDG 44 309 309 3 4.5 2.54 16 15 15 BLDG 4015 121 121 1.2 12 20 20 BLDG 16 276 276 2.54 3 6 17

Card 21----- Thermostat Parameters -----Cooling Room Cooling Cooling Heating Heating Heating T'stat Mass / Carpet ROOM Poom Design T'stat T'stat Room T'stat T'stat Location No. Hrs Dn Driftpoint Schedule Design DB Driftpoint Schedule Flag Number Design DB RH Average Floor 78 5 70 70 50 78 ROOM LIGHT30 NO 10 78 50 78 70 70 ROOM LIGHT30 NO 15 78 50 78 70 70 ROOM LIGHT30 NO

70

70

ROOM

LIGHT30 NO

Card 22	2			Roof Par	ameters				
		Roof							
Room	Roof	Equal to	Roof	Roof	Roof	Const	Roof	Roof	Roof
Number	Number	Floor?	Length	Width	U-Value	Type	Direction	Tilt	Alpha
5	1	YES			.10	47		67	.9
10	1	NO	221	221	.09	23		90	.9
15	1	NO	245	39	.22	47		90	.74
20	1	NO	1582	34	.10	47		60	.74

					Wall				Ground
Room	Wall	Wall	Wall	Wall	Constuc	Wall	Wall	Wall	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
5	1	153	14	.26	58	90		.74	
5	2	30	14	.26	58	0		.74	
5	3	17	14	.13	88	0		.74	
5	4	181	14	.13	88	270		.74	
5	5	45	14	.13	88	180		.74	
5	6	28	14	.13	88	90		.74	
10 :	1	200	16	.19	58	0		.9	
10	2	232	16	.19	58	180		.9	
10	3	230	16	.19	58	270		.9	
10	4	364	16	.18	88	0		.74	
10	5	482	16	.18	88	90		.74	
10	6	342	16	.18	88	180		.74	
10	7	260	16	.18	88	270		.74	
15	1	39	12	.22	52	0		.74	
15	2	245	12	.22	52	90		.74	
15	3	39	12	.22	52	180		.74	
15	4	245	12	.22	52	270		.74	
20	1	600	15.5	.2	64	0		.74	
20	2	1016	15.5	.2	64	90		.74	
20	3	600	15.5	.2	64	180		.74	
20	4	1016	15.5	.2	64	270		.74	

				Pct Glass			External	Internal	Percent		Inside
loom	Wall	Glass	Glass	or No. of	Glass	Shading	Shading	Shading	Solar to	Visible	Visible
umber	Number	Length	Width	Windows	U-Value	Coefficient	Type	Type	Ret. Air	Transmittance	Reflectand
	1	3.5	6.5	16	1.1	.67					
	2	3.5	6.5	1	1.1	.67					
	4	2.5	3	12	1.1	1					
	5	3.5	6.5	4	1.1	.67					
0	1	5	8	17	1.1	.67					
0	2	5	8	13	1.1	.67					
0	3	5	8	17	1.1	.67					
0	4	3.5	8	29	1.1	.67					
0	5	3.5	8	51	1.1	.67					
10	6	3.5	8	57	1.1	.67					

				Pct Glass				Internal			Inside
Room	Wall	Glass		or No. of		Shading	Shading	Shading		Vicible	Visible
iumber	Number			Windows	U-Value	-	-	-	Solar to	Transmittance	
10	7	3.5		21	1.1	.67	Туре	Type	Ket. Air	Transmit tance	Reflectance
15	1	3.5		11	1.1	.67					
15	2	3		89	1.1						
			-			.67					
15	3	3		10	1.1	.67					
15	4	3		96	1.1	.67					
20	1	_		48	.56	1					
20	2	3		56	1.1	.67					
20	3	3		84	1.1	.67					
20	4	3	6	56	1.1	.67					
Card 26	,					Schedules	• • • • • • • • • • • • • • • • • • • •	•••••			••••
Room						Reheat	Cooling	Heating A	uxiliary	Room Dayligi	hting
Number	People	Lights	Ventil	ation In	filtration	Minimum !	Fans	Fan F	an	Exhaust Contro	ls
5	FSHOFFI	C FSHOFE	10								
10	FSHOFFI	C FSHOFE	10								
15	FSHOFFI	C FSHOFE	10								
20	FSHOFFI	C FSHOFE	10								
Card 27	'		• • • • • • • • • • • • • • • • • • • •		People		ghting			Daylighting	
Room	People	People	People	People	Lighting	Lighting Fi	xture Ba	illast Ligh	ts to Ref	erence Referen	ce
Number	Value	Units	Sensible	Latent	Value	Units Ty	pe Fa	sctor Ret.	Air Poi	nt 1 Point 2	
5	64	PEOPLE	250	200	2	WATT-SF AS	HRAE2				
10	500	PEOPLE	250	200	2.5	WATT-SF SU	SFLUOR				
15	110	PEOPLE	250	200	2	WATT-SF SU	SFLUOR				
20	150	SF-PERS	250	200	2.25	WATT-SF AS	HRAE2				
Card 28			•••••					nt			
				Ener		-	Energy	Percent		Percent	
	Misc				rem Canal	ump Schedule	Motor	of Load	Misc. Los	ad Misc. Sens	Radiant Option
	Equipme	nt Equi			•	•					
Number	Equipme Number	Desc	rip	Valu	e Unit	Code	Code		to Room	to Ret. Air	Fraction Air Pa
Number 5	Equipme Number 1	COMP	rip UTER	Valu 1	e Unit	Code SF FSHOFFIC	Code			to Ret. Air	Fraction Air Pa
Number 5 10	Equipme Number 1	COMPI	rip UTER UTER	Valu 1 2	Unit: WATT	SF FSHOFFIC	Code			to Ret. Air	Fraction Air Pa
Number 5 10	Equipme Number 1	COMP	rip UTER UTER	Valu 1	Unit: WATT	Code SF FSHOFFIC	Code			to Ret. Air	Fraction Air Pa
Room Number 5 10 15 20	Equipme Number 1	COMPI	rîp UTER UTER UTER	Valu 1 2	WATT	SF FSHOFFIC	Code			to Ret. Air	Fraction Air Pa
Number 5 10 15 20	Equipme Number 1 1 1	Desci Compi Compi Compi	TIP UTER UTER UTER UTER	Valu 1 2 2.5 1.25	WATT	Code SF FSHOFFIC SF FSHOFFIC SF FSHOFFIC	Code	Sensible	to Room	to Ret. Air	
Number 5 10 15 20 Card 29	Equipme Number 1 1 1 1	Desci COMPI COMPI COMPI	rip UTER UTER UTER UTER	Valu 1 2 2.5 1.25	Unit: WATT: WATT: WATT: WATT:	S Code SF FSHOFFIC SF FSHOFFIC SF FSHOFFIC SF FSHOFFIC	Code	Sensible	to Room		
Number 5 10 15 20 Card 25	Equipme Number 1 1 1 1	Desci Compi Compi Compi	TIP UTER UTER UTER UTER UTER UTER	Valu 1 2 2.5 1.25	WATT	Code SF FSHOFFIC SF FSHOFFIC SF FSHOFFIC SF FSHOFFIC	Code	Sensible	to Room	Reheat Minimu	

		Venti	lation				-Infiltra	ation				
Room	Cool	ing	Не	ating		Cooling-	••••	Hea	ating	Reh	eat Minis	num
Number	Value	Units	Value	Uni	ts Val	ue U	nits	Value	Units	Value	·	Jni ts
10	20	CFM-P	20	CFM	-P							
15	15	CFM-P	15	CFM	-P							
20	20	CFM-P	20	CFM	-р							
•••••		Syste	m Section	Alterna	tive #1	•••••		•				
Card 39	- System A	lternative										
Number	De	scription										
1	EX	ISTING SYS	TEM									
Card 40)		System	туре				-				
			OPTIONA	L VENTIL	TEYE WOLTA	EH						
System		Ventil					Fan					
Set	System	Deck	Cooling	Heating	Cooling	Heating	Static					
Number		Location	SADBVh	SADBVh	Schedule	Schedul e	Pressur	е				
1	MZ											
2	SZ											
3	MZ											
4	SZ											
	1			• • • • • • • • • • • • • • • • • • • •	Zone /	Nssignment						
System Set		ef #1	Ref	#2	Ref	47	Ref	41.	Ref #	4 C	Ref	44
			Begin		Begin		Begin	End	Begin	End	Begin	₽O En
	5 Beg 11	5	begin	EIIG	begin	EIRI	Begin	EIRI	begin	EIRI	begin	EII
Number		10										
Number 1												
Number 1 2	10											
Number 1 2 3	10 15	15										
Number 1 2	10											

System Cool Heat Return Mn Exh Aux Rm Exh Cool Return Supply Supply Return Set Fan Fan Fan Fan Fan Fan Fan Fan Mtr Fan Mtr Duct Duct Air Number SP SP SP SP SP SP Loc Loc Ht Gn Loc Path

1 2.0 2

3

1.5

1.5

```
Card 42----- Fan SP and Duct Parameters-----
System Cool Heat Return Mn Exh Aux Rm Exh Cool Return Supply Supply Return
Set Fan Fan Fan Fan Fan Fan Htr Fan Htr Duct Duct Air
Number SP SP SP
                 SP SP SP Loc Loc Ht Gn Loc Path
4 1.5
Card 45----- Equipment Schedules -----
            Direct Indirect Auxiliary Main Main
System Main
                                Auxiliary Main Main Auxiliary
Cooling Heating Preheat Reheat Mech. Heating
Set Cooling
Set Cooling Evap Evap
Number Coil Economizer Coil Coil
                        Evap
                                       Coil Coil Coil Humidity Coil
                               Coil
    FTSAMCLG
                                       FTSAMHTG
    FTSAMCL G
2
                                       FTSAMHTG
    FTSAMCLG
                                       FTSAMHTG
4
    FTSAMCLG
                                       FTSAMHTG
----- Equipment Section Alternative #1 ------
Card 59----- Equipment Description / TOD Schedules ------
      Elec Consump Elec Demand Demand
Alternative Time of Day Time of Day Limit
                                                             Temperature
Number Schedule Schedule Max KW Alternative Description
                                                        Schedule Drift
                             BASE CASE
Card 60----- Cooling Load Assignment-----
Load All Coil Cooling
Asgn Loads To Equipment -Group 1- -Group 2- -Group 3- -Group 4- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-
Ref Cool Ref Sizing Begin End Begin End
         BLKPLANT 1 1
   1
         BLKPLANT 2
                    2
3 5
         BLKPLANT 3 3
   6
         BLKPLANT 4
Card 62----- Cooling Equipment Parameters
Cool Equip Num ------COOLING-----
                                     Ref Code
         Of
             --Capacity--
                        ----Energy----
                                      --Capacity-- ---Energy----
                                                               Order Seq Limit
Num Name
         Units Value Units
                                    Value Units
                         Value Units
                                                  Value Units
                                                               Num Type Number
  QUADACRE 1 30 TONS
                       49
   QUADACRE 1
                        114
2
            65 TONS
                               KU
                                                                    PAR
            95 TONS
95 TONS
   QUADACRE 1
                         167
                               KW
                                                                    PAR
                                                               2
                         167
```

KW

KW

88.4 KW

194

QUADACRE 1 120 TONS

50 TONS

QUADACRE 1

5 QUADACRE 1

3

1

PAR

PAR

Cool	Equip	Num		coo	LING			HEAT F	ECOVERY		\$eq		Demand
Ref	Code	Of	Capa	city	Ene	rgy	Capa	city	Ene	rgy	Order	Seq	Limit
Num	Name	Units	Value	Units	Value	Units	Value	Units	Value	Units	Num	Туре	Number
7	QUADACRE	1	110	TONS	190	KW					2	PAR	

```
Card 63----- Cooling Pumps and References -----
Cool --- CHILLED WATER---- ---- CONDENSER----- --- HT REC or AUX---- Switch-
Ref Full Load Full Load Full Load Full Load Full Load Full Load over Cold Cooling Misc.
                 Value Units Value Units Control Storage Tower Access.
Num Value
           Units
1 3.73
           KW
                                                                       3
2 14.92
           KW
3 3.73
           KV
4 3.73
5 3.73
           KW
           KW
6 5.6
           KW
                                                                       2
```

Card 65				• • • • • • • • • • • • • • • • • • • •	Heating	Load Assign	ment	•••••			
Load	All Coil										
Assignment	Loads To	-Grou	ир 1-	-Group 2-	-Group 3-	-Group 4-	-Group 5-	-Group 6-	-Group 7-	-Group 8-	-Group 9-
Reference	Heating Ref	Begir	End	Begin End	Begin End	Begin End	Begin End	Begin End	Begin End	Begin End	Begin End
1	1	1	1	4 4							
2	3	2	2								
3	15	3	3								

Card 67	····				Неа	ting Equ	ipment Pa	rameters						
Heat	Equip	Number	HW Pmp				Energy		Seq	Switch				Demand
Ref	Code	Of	Full Ld		Cap'y		Rate		Order	over	Hot	Misc.		Limit
Number	Name	Units	Value	Units	Value	Units	Value	Units	Number	Control	Strg	Acc.	Cogen	Number
1	QUAEXIST	1			3587	MBH	5000	MBH	1					
2	QUAEXIST	1			1614	MBH	2250	MBH	2					
3	QUAEXIST	1			264	MBH	385	MBH	1					
4	QUAEXIST	1			264	MBH	385	MBH	2					
5	QUAEXIST	1			264	MBH	385	MBH	3					
6	QUAEXIST	1			264	MBH	385	MBH	4					
7	QUAEXIST	1			264	MBH	385	MBH	5					
8	QUAEXIST	1			264	HBH	385	MBH	6					
9	QUAEXIST	1			264	MBH	385	MBH	7					
10	QUAEXIST	1			236	MBH	335	MBH	8					
11	QUAEXIST	1			236	MBH	335	MBH	9					
12	QUAEXIST	1			236	MBH	335	MBH	10					
13	QUAEXIST	1			236	MBH	335	MBH	11					
14	QUAEXIST	1			236	MBH	335	MBH	12					
15	E92001	1	2.24	KW	741	MBH	1000	MBH				1		

Jtility Number				Hour	ly Hou	urly			Equi	р	Demand				
lumber	Utili	ity		Dema	nd Der	nand :	Schedule	Energy	Refe	rence	Limiting	Entering	Leaving	3	
	Desci	rip		Valu	e Un	its (Code	Type	Numb	er	Number	Temp	Temp		
1	PIPE	PUMP HT	LOS	1.6	TO	is i	FTSAMCLG	CHILL-L	D 1						
2	PIPE	HT LOSS		68.1	MB	4 1	FTSAMHTG	HOT-LD	1						
	PIPE	PUMP HT	LOS	10.2	TO	NS :	FTSAMCLG	CHILL-L	.D 2						
	PIPE	HT LOSS		54.5	MBI	4	FTSAMHTG	HOT-LD	2						
i	PIPE	PUMP HT	LOS	2.5	TO	NS I	FTSAMCLG	CHILL-L	.D 5						
5	PIPE	HT LOSS		17.7	1 MBI	4	FTSAMHTG	HOT-LD	14						
,	PIPE	PUMP HT	LOS	5.9	TO	NS :	FTSAMCLG	CHILL-L	.D &						
and 75.							Miccel La	nanus Aca							
#1						#2	HISCELLA	rieous Acc	essoi y		#3				
lisc Eq		Energ	,	Energy	Sched	Equ	io F	nergy	Energy	Sched		Energ	v Ene	ergy S	Sched
	xde	Value		Units		Cod	•		Units	Code		Value	•		Code
	5240	3.73		KW		-50	•			2000	-	74140	5111		
	5001	5.6		KW		EQ5	105 9	.33	KW						
	5001	3.73		KW											
Card 59-					Equi	pment	Descript	ion / T00) Schedu	ıles					
ard 59-					Equi		Descript	ion / T00) Schedu	ıles			mand Lin		
		Elec Con	sump	Elec D		emand	Descript	ion / T00) Schedu	ıles			mand Li		-
	tive	Elec Con	sump Day	Elec D	emand D	emand imit	Alterna	iion / TOO Itive Desc REW CHILI	cription				mand Lin Tempo	mit	-
Alternat Number 2 Card 60-	tive	Elec Con Time of Schedule	sump Day	Elec D Time of Schedu	emand D of Day L ale M	emand imit ax KW	Alterna A.C. SC	itive Desc	cription LERS	1		De Schedul	emand Lin Tempo e Do	mit eratur rift	-
Alternat Number 2 Card 60- Load Al	tive	Elec Con Time of Schedule	sump Day	Elec D Time o Schedu	emand D of Day L ile M	emand imit ax KW	Alterna A.C. SC	itive Desc REW CHILI	cription LERS Assign	n ment		De	emand Lin Tempo e Di	mit eratur rift	- e
Alternat Aumber 2 Card 60- Load Al	tive	Elec Con Time of Schedule	sump Day ng ment	Elec D Time o Schedu	pemand D of Day L ile M	emand imit ax KV	Alterna A.C. SC Cool	itive Desc REW CHILI ing Load	cription LERS Assigna oup 4-	nent		Schedul	emand Lin Tempo e Do	mit eratur rift	- e
Alternat Number 2 Card 60- Load Al Asgn Lo	ll Coi	Elec Con Time of Schedule Cooli O Equip	sump Day ng ment	Elec D Time o Schedu	emand D of Day L ule M of 1- Gr End Beg	emand imit ax KV	Alterna A.C. SC Cool	itive Desc REW CHILI ing Load	cription LERS Assigna oup 4-	nent		Schedul	emand Lin Tempo e Do	mit eratur rift	e 8Group
Alternat Alumber 2 Card 60- Load Al Alsgn Lo	ll Coi	Elec Con Time of Schedule Cooli O Equip	sump Day ng ment	Elec D Time o Schedu -Group Begin	emand D of Day L ule M of 1- Gr End Beg	emand imit ax KV	Alterna A.C. SC Cool	itive Desc REW CHILI ing Load	cription LERS Assigna oup 4-	nent		Schedul	emand Lin Tempo e Do	mit eratur rift	e 8Group
Alternat Number 2 Card 60- Load Al Asgn Lo Ref Cc I 1	ll Coi pads T pool Re	Elec Con Time of Schedule	sump Day ng ment g ANT	Elec D Time of Schedu -Group Begin 1	emand D of Day L ile M o 1Gr End Beg	emand imit ax KW	Alterna A.C. SC Cool -Group Begin	itive Desc REW CHILI ing Load 5 3Gr End Beg	cription LERS Assignm oup 4- in End	nent -Group Begin	o 5Grow End Begin	Schedul	mand Lir Tempe e Di	mit eratur rift Group Begin	8Group End Begin &
Alternat Number 2 Card 60- Load Al Asgn Lo Ref Co 1 1	ll Coi oeds T ool Re	Elec Con Time of Schedule L Cooli o Equip f Sizin BLKPL	og ment g ANT	Elec D Time of Schedu	emand D of Day L ile M of 1-Gr End Beg 4	emand imit ax KW	Alterna A.C. SC Cool -Group Begin	itive Description of the CHILL	Assignmoup 4- in End	nent -Group Begin ers	p 5Grow End Begin	Schedul	mand Lir Tempo e Di	mit eratur rift -Group Begin	8Group End Begin N
Alternat Number 2 Card 60- Load Al Asgn Lo Ref Co 1 1	ll Coi pool Re	Elec Con Time of Schedule L Cooli O Equip f Sizin BLKPL	ng ment g	Elec D Time of Schedu	emand D of Day L ile M of Tay L	emand imit ax KW	Alterna A.C. SC Cool -Group Begin	itive Description of the CHILLI	Assignmoup 4- in End Paramete	nent -Group Begin ers EAT REI	p 5Groot End Begin COVERY	Schedul	mand Lir Tempo e Di Dup 7- in End !	mit eratur rift -Group Begin	8Group End Begin I Demand Limit
Alternat Number 2 Card 60- Load Al Asgn Lo Ref Co 1 1 Card 62- Cool Equ Ref Cool	ll Coi pool Re	Elec Con Time of Schedule L Cooli O Equip f Sizin BLKPL	ng ment g	Elec D Time of Schedu Group Begin 1	emand D of Day L le M of Day L o	emand imit ax KW	Alterna A.C. SC Cool -Group Begin	itive Description of the CHILLI	Assignmoup 4- in End	nent -Group Begin ers EAT REI	p 5Grow End Begin	Schedul	mand Lir Tempo e Di	mit eratur rift -Group Begin	8Group End Begin I Demand Limit

	l Load ue 38	WATER Full Load Units KW KW					oad over		Cooling Tower 1	Misc. Access.	
ard 71 lase Itility Iumber	Base Utilit Descri	ty	Hourly Demand Value	Hourly Demand Units	Schedule Code	arameters Energy Type CHILL-LD	Equip Reference Number	Demand Limiting Number		_	
C Ower T Ref C	cooling		Capacity Units	Energy Consump	/ Cooling Energy Consump Units KW	Fluid	Nower O		nt Low Sp ow Energy	d Low Spd Energy	
		Equ	ipment Sect	ion Alter	native #3		• • • • • • • • • • • • • • • • • • • •	••			
Card 59- Alternat	E tive T		Elec Dema	Equipment and Demand Day Limit	Descripti Alterna	ion / TOO S	Schedules iption		Schedu	emand Limit Temperature le Drift	
Card 59- Alternat Number 3 Card 65- Load Assignm	E tive T S	ilec Consump ime of Day ichedule il Coil pads To eating Ref	Elec Dema Time of D Schedule	Equipment and Demand Day Limit Max KW	Descripti Alterna EXIST S'	ion / TOO S tive Descr TEAM BLR W g Load Ass Group	iption ITH NEW HU ignment	IH GENERATOR	Schedu	emand Limit Temperature	-Group 9

Card 71-			Base	Utility P	arameters				
Base	Base	Hourly	Hourly			Equip	Demand		
Utility	Utility	Demand	Demand	Schedule	Energy	Reference	Limiting	Entering	Leaving
Number	Descrip	Value	Units	Code	Туре	Number	Number	Temp	Temp
1	PIPE HT LOSS	140.3	MBH	FTSAMHTG	HOT-LD	1			

Card	75				Misc	ellaneous 🖊	ccessory					
	#1				#2		·		#3			
Misc	Equip	Energy	Energy	Sched	Equip	Energy	Energy	Sched	Equip	Energy	Energy	Sched
Ref	Code	Value	Units	Code	Code	Value	Units	Code	Code	Value	Units	Code
1	EQ5020	2.24	KW									

Utility Description Reference Table

•••••

Schedules:

FSHOFFIC F.S.H. OFFICE INTERNAL LOAD SCHEDULE

FTSAMCLG EEAP BOILER/CHILLER STUDY

FTSAMHTG EEAP BOILER/CHILLER STUDY

System:

MZ MULTIZONE

SZ SINGLE ZONE

Equipment:

Cooling:

EQ1510 AIR COOLED SERIES R (RTAA)

QUADACRE QUAD AIR COOLED RECIP CHILLER(S)

Heating:

EQ2001 GAS FIRED HOT WATER BOILER

QUAEXIST QUAD AREA EXIST STEAM BOILER

Tower

EQ5200 CONDENSER FANS

Misc:

EQ5001 CHILLED WATER PUMP - CONSTANT VOLUME

EQ5020 HEATING WATER CIRCULATION PUMP

EQ5105 EVAPORATIVE CONDENSER FANS

EQ5240 BOILER FORCED DRAFT FAN

030185.04 EEAP BOILER-CHILLER STUDY
FT. SAM HOUSTON - SAN ANTONIO, TX.
CORPS OF ENGINEERS - FORT WORTH, TEXAS
HUITT - ZOLLARS INC.
QUADANGLE AREA

Weather File Code:

 Location:
 SAN ANTONIO, TEXAS

 Latitude:
 29.0 (deg)

 Longitude:
 98.0 (deg)

 Time Zone:
 6

 Elevation:
 792 (ft)

 Barometric Pressure:
 29.0 (in. Hg)

 Summer Clearness Number:
 0.90

 Winter Clearness Number:
 0.90

 Summer Design Dry Bulb:
 97 (F)

 Summer Design Wet Bulb:
 76 (F)

 Winter Design Dry Bulb:
 30 (F)

 Summer Ground Relectance:
 0.20

 Winter Ground Relectance:
 0.20

Air Density: 0.0738 (Lbm/cuft)
Air Specific Heat: 0.2444 (Btu/lbm/F)
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: June To November
System Simulation Period: January To December
Cooling Load Methodology: TETD/Time Averaging

Time/Date Program was Run: 8:28:39 6/12/95
Dataset Name: FSH4ANGL .TM

SYSTEM LOAD PROFILE

System Totals

Percent	Cooling L	bao	Heatin	g Load	•••••
Design	Cap. Hour	s Hours	Capacity	Hours	Hours
Load	(Ton) (X)	(8tuh)	(%)	
0 - 5	27.8 1	4 569	-140,290	57	907
5 - 10	55.5	9 371	-280,581	8	124
10 - 15	83.3 1	1 430	-420,871	6	100
15 - 20	111.1	8 307	-561,161	5	80
20 - 25	138.8	9 351	-701,452	3	48
25 - 30	166.6	9 346	-841,742	4	60
30 - 35	194.3	6 246	-982,032	5	81
35 - 40	222.1	2 73	-1,122,323	2	25
40 - 45	249.9	3 129	-1,262,613	0	6
45 - 50	277.6	4 141	-1,402,904	3	54
50 - 55	305.4	3 108	-1,543,194	6	99
55 - 60	333.2	3 131	-1,683,484	7 1	16
60 - 65	360.9	2 86	-1,823,775		0
65 - 70	388.7	3 131	-1,964,065	0	0
70 - 75	416.5	3 128	-2,104,355	0	0
75 - 80	444.2	4 168	-2,244,646	0	0
80 - 85	472.0	4 172	-2,384,936	0	0
85 - 90	499.8	1 43	-2,525,227	0	0
90 - 95	527.5	1 43	-2,665,517	0	0
95 - 100	555.3	0 0	-2,805,807	0	0
Hours Off	0.0	0 4,787	0	0	7,160

Trane Air Conditioning Economics
By: HUITT & ZOLLARS

PK

0.5

0.5

0.5

0.5

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

------ EQUIPMENT ENERGY CONSUMPTION ----------- Monthly Consumption -----Ref Equip Num Code Feb Har May June Total Jan Apr July Aug Seo Oct Nov 0 LIGHTS ELEC 77510 70128 84891 73819 81200 81200 73819 84891 73819 81200 73819 73819 930,115 455.7 PK 455.7 455.7 455.7 455.7 455.7 455.7 455.7 455.7 455.7 455.7 455.7 455.7 1 MISC LD ELEC 0 0 0 0 0 0 0 0 0 0 0 0 0 PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 2 MISC LD GAS 0 ٥ 0 0 0 0 0 0 0 0 0 0 0 PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 3 MISC LD OIL 0 0 0 0 0 0 0 0 0 0 0 0 0 DK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 4 MISC LD P STEAM 0 0 0 0 0 0 0 0 0 0 0 PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 5 HISC LD P HOTH20 0 0 0 0 0 0 ٥ 0 0 0 0 0 n PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 6 MISC LD P CHILL Đ 0 0 0 0 0 0 0 0 0 0 0 0 PK 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 BASE UTILITY CHILLD 0 0 0 0 1190 1152 1190 1190 1152 0 0 1190 7,066 PK 0.0 0.0 0.0 0.0 1.6 1.6 1.6 1.6 1.6 1.6 0.0 0.0 1.6 BASE UTILITY HOTLD 507 458 507 490 O 0 D 490 507 2,958 n 0 0 PK 0.7 0.7 0.7 0.7 0.0 0.0 0.0 0.0 0.0 0.0 0.7 0.7 0.7 BASE UTILITY CHILLD O 0 0 45,043 0 7589 7344 7589 7589 7344 7589 0 Ō PK 0.0 0.0 0.0 0.0 10.2 10.2 10.2 10.2 10.2 10.2 0.0 0.0 10.2 BASE UTILITY HOTLD 405 366 405 392 O ō 0 0 0 0 392 405 2,367

0.0

0.0

0.0

0.0

0.0

0.0

0.5

0.5

0.5

BASE CASE

ef	Equip					Mont	nty tons	umption						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	0ct	Nov	Dec	Total
5			BASE	UTILITY										
	CHILLD	0	0	0	0	1860	1800	1860	1860	1800	1860	0	0	11,040
	PK	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0	2.5
6			BASE	UTILITY										
	HOTLD	132	119	132	128	0	0	0	0	0	0	128	132	769
	PK	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2
7			BASE	UTILITY										
	CHILLD	0	0	0	0	4390	4248	4390	4390	4248	4390	0	0	26,054
	PK	0.0	0.0	0.0	0.0	5.9	5.9	5.9	5.9	5.9	5.9	0.0	0.0	5.9
1			QUAD	AIR COOL	ED REC	P CHILLE	R(S)							-
	ELEC	0	0	0	0	11383	13937	16680	16889	12081	5786	0	0	76,755
	PK	0.0	0.0	0.0	0.0	36.9	40.4	43.9	44.1	37.5	27.4	0.0	0.0	44.1
1	E95001		CHIL	LED WATER	PUMP -	- CONSTA	NT VOLUE	Æ						
	ELEC	0	0	0	0	2775	2686	2775	2775	2686	2775	0	0	16,472
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
1	EQ5300		CONT	ROL PANEI	. & INTI	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1	EQ5001		CHIL	LED WATER	R PUMP	- CONST	ANT VOLUE	1E						<u> </u>
	ELEC	0	0	0	0	2775	2686	2775	2775	2686	2775	0	0	16,472
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
2			QUAD	AIR COO	LED REC	IP CHILL	ER(S)							}
	ELEC	0	0	0	0	46937	51983	56803	57761	50614	32096	0	0	296,194
	PK	0.0	0.0	0.0	0.0	98.2	106.1	113.6	115.1	103.4	93.6	0.0	0.0	115.1
2	E95001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	4E						-
	ELEC	0	0	0	0	11100	10742	11100	11100	10742	11100	0	0	65,887
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9
2	E95300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
3			QUAD	AIR COO	LED REC	IP CHILL	ER(S)							
	ELEC	0	0	0	0	32997	43350	54743	56746	34944	20449	0	0	243,23
	PK	0.0	0.0	0.0	0.0	143.1	155.5	166.4	168.7	151.4	137.2	0.0	0.0	168.7

BASE CASE

et	Equip					Mont	tilly cons	sumption						
UM	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
3	E95001		CHILL	ED WATER	R PUMP -	CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	1071	1417	1768	1790	1119	656	0	0	7,82
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.
3	EQ5300		CONT	ROL PANEI	. & INTE	RLOCKS								
	ELEC	0	0	0	0	287	380	474	480	300	176	0	0	2,09
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.
4			QUAD	AIR COO	LED RECT	IP CHILLI	ER(S)							
	ELEC	0	0	0	0	16188	19446	21238	24712	17761	4890	0	0	104,2
	PK	0.0	0.0	0.0	0.0	143.1	155.5	166.4	168.7	151.4	121.0	0.0	0.0	168
4	EQ5001		CHILI	LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	492	574	597	686	522	164	0	0	3,0
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3
4	EQ5300		CONT	ROL PANE	L & INTI	ERLOCKS								
	ELEC	0	0	0	0	132	154	160	184	140	44	0	0	8
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1
5			QUAD	AIR COO	LED REC	IP CHILL	ER(S)							
	ELEC	0	0	0	0	27434	32405	38181	38370	28141	15749	0	0	180,2
	PK	0.0	0.0	0.0	0.0	83.1	86.8	90.0	89.3	83.4	76.9	0.0	0.0	90
5	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						-
	ELEC	0	0	0	0	2775	2686	2775	2775	2686	2775	0	0	16,4
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3
5	EQ5300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,4
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1
6			QUAD			IP CHILL	ER(S)							
	ELEC	0	0	0	0	56711	73757	86637	85892	62230	27804	0	0	393,0
	PK	0.0	0.0	0.0	0.0	159.0	185.9	188.5	189.2	166.5	157.2	0.0	0.0	189
6	E95001			LED WATE			ANT VOLU	ME						-
	ELEC	0	0	0	0	4166	4032	4166	4166	4032	4166	0	0	24,7
	PK	0.0	0.0	0.0	0.0	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0	5
6	EQ5300			ROL PANE										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,4
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1

PK

0.1 0.1

0.0

0.0

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0.0 0.0

0.0

0.0

0.0

0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 BASE CASE

Ref	Equip					Mon	thly Con	sumption						
	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	0ct	Nov	Dec	Total
6	E95001		CHIL	LED WATE	R PUMP -	CONST	ANT VOLUI	ME						
	ELEC	0	0	0	0	4166	4032	4166	4166	4032	4166	0	0	24,730
	PK	0.0	0.0	0.0	0.0	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0	5.6
6	E95105		EVAP	ORATIVE	CONDENSE	R FANS								•
	ELEC	0	0	0	0	6942	6718	6942	6942	6718	6942	0	0	41,201
	PK	0.0	0.0	0.0	0.0	9.3	9.3	9.3	9.3	9.3	9.3	0.0	0.0	9.3
7			QUAD	AIR COO	LED REC	P CHILL	ER(S)							
	ELEC	0	0	0	0	19262	20759	27811	31913	18382	4632	0	0	122,759
	PK	0.0	0.0	0.0	0.0	155.6	170.6	184.6	185.3	160.4	119.9	0.0	0.0	185.3
7	EQ5001		CHIL	LED WATE	R PUMP	CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	E95300		CONT	ROL PANE	L & INT	RLOCKS								
	ELEC	0	0	0	0	154	154	200	230	140	44	0	0	922
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1			QUAD	AREA EX	IST STE	M BOILE	R							
	GAS	2063	1913	207	0	0	0	0	0	0	0	350	1977	6,509
	PK	11.5	12.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	11.4	12.0
1	E95311		BOIL	ER CONTR	OLS									
	ELEC	57	53	11	0	0	0	0	0	0	0	17	55	192
	PK	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
2			QUAD	AREA EX	IST STE	AM BOILE	R							
	GAS	277	239	619	684	0	0	0	0	0	0	556	292	2,665
	PK	1.0	1.0	1.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
2	E95311		BOIL	ER CONTR	OLS									
	ELEC	36	31	81	90	0	0	0	0	0	0	73	38	351
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
3			QUAD	AREA EX	IST STE	AM BOILE	R							
	GAS	374	347	0	0	0	0	0	0	0	0	0	308	1,029
	PK	3.8	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8
3	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	14	13	0	0	0	0	0	0	0	0	0	11	38

0.1

BASE CASE

ef	Equip							-					_	
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
4			QUAD	AREA EX	ST STEA	4 BOILER								
	GAS	262	221	0	0	0	0	0	0	0	0	0	180	66
	PK	3.8	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.
4	EQ5311		BOIL	ER CONTRE	DLS									
	ELEC	11	9	0	0	0	0	0	0	0	0	0	8	2
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.
5			QUAD	AREA EX	IST STEAL	H BOILER								
	GAS	5	20	0	0	0	0	0	0	0	0	0	8	3
	PK	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.
5	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	3	4	0	0	0	0	0	0	0	0	0	2	
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.
6			QUAD	AREA EX	IST STEA	M BOILER								
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	0	0	0	0	0	0	O	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
7			QUAD	AREA EX	IST STEA	M BOILER								
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
7	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
8			QUAD	AREA EX	IST STEA	M BOILER								
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
8	EQ5311		BOIL	ER CONTR	ols									
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
9			QUAD	AREA EX	IST STEA	M BOILER								
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.

BASE CASE

T	Equip					HOILE	ity cons	Calperon						
FFI	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	0ct	Nov	Dec	Tota
9	E95311		BOILE	ER CONTRO	OLS									
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
0			QUAD	AREA EX	IST STEA	M BOILER								
	GAS	1	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
0	E95311		BOIL	ER CONTR	OLS									
	ELEC	1	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1			QUAD	AREA EX	IST STEA	M BOILER								
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2				AREA EX										
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2	EQ5311			ER CONTR										
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
5				AREA EX										
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
5	EQ5311			ER CONTR										
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
•				AREA EX										
	GAS	0	0	0	0	0	O	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
,	EQ5311			ER CONTR										
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 BASE CASE

Ref	Equip					Mont	hly Cons	umotion						
	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
15	E92001		GAS	FIRED HO	T WATER	BOILER								
	GAS	392	351	23	0	0	0	0	0	0	0	59	379	1,204
	PK	2.9	3.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.9	3.0
15	EQ5020		HEAT	ING WATE	R CIRCUL	ATION PU	MP							
	ELEC	562	484	72	0	0	0	0	0	0	0	161	542	1,821
	PK	2.2	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2	2.2
15	EQ5240		BOIL	ER FORCE	DORAFT	FAN								
	ELEC	1361	806	358	0	0	0	0	0	0	0	828	921	4,275
	PK	3.7	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	7,21,3

A.C. SCREW CHILLERS

f	Equip					Mor	thly Cor	sumption						
m	Code	Jan	Feb	Mar	Apr	Hay	June	July	Aug	Sep	Oct	Nov	Dec	Tota
0	LIGHTS													
	ELEC	77510	70128	84891	73819	81200	81200	73819	84891	73819	81200	73819	73819	930,11
	PK	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.
	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	Ð	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
			BASE	EUTILITY	r									
	CHILLD	0	0	0	0	15029	14544	15029	15029	14544	15029	0	0	89,20
	PK	0.0	0.0	0.0	0.0	20.2	20.2	20.2	20.2	20.2	20.2	0.0	0.0	20
	EQ1510		AIR	COOLED S	SERIES R	(RTAA)								
	ELEC	0	0	0	0	88155	109763	136458	139682	93439	39506	0	0	607,00
	PK	0.0	0.0	0.0	0.0	287.6	328.3	351.0	351.0	306.5	271.9	0.0	0.0	351
	E95200		CON	DENSER FA	ANS									
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	EQ5001		CHI	LLED WATE	ER PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	16651	16114	16651	16651	16114	16651	0	0	98,8
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22

A.C. SCREW CHILLERS

	Equip						thly Con:	sumption						
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5302		CONT	ROLS										
	ELEC	0	0	0	0	74	72	74	74	72	74	0	0	442
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1
2	EQ1510		AIR	COOLED S	ERIES R	(RTAA)								
	ELEC	0	0	0	0	37029	47686	52699	56867	42171	17101	0	0	253,553
	PK	0.0	0.0	0.0	0.0	287.6	328.3	351.0	351.0	306.5	216.4	0.0	0.0	351.0
2	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	HE						
	ELEC	0	0	0	0	3939	4924	4924	5147	4476	2350	0	0	25,759
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
2	EQ5302		CONT	ROLS										
	ELEC	0	0	0	0	18	22	22	23	20	11	0	0	115
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3 EXIST STEAM BLR WITH NEW HWH GENERATOR

ef	Equip					Mon	thly Cons	sumption						
	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	77510	70128	84891	73819	81200	81200	73819	84891	73819	81200	73819	73819	930,115
	PK	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	. 0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1			BAS	E UTILIT	Υ									
	HOTLD	1044	943	1044	1010	0	O	0	0	0	0	1010	1044	6,09
	PK	1.4	1.4	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.4	1.
1			QUA	D AREA E	XIST ST	AM BOILE	R							
	GAS	4107	3752	1598	1408	0	0	0	0	0	0	1692	3883	16,4
	PK	23.0	24.3	8.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	23.1	24.
1	EQ5311		801	LER CONT	ROLS									
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	5
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0
1	EQ5020		HEA	TING WAT	ER CIRC	JLATION F	PUMP							
	ELEC	1667	1505	1667	1613	0	0	0	0	0	0	1613	1667	9,7
	PK	2.2	2.2	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2	2

01 Card - Job Information

Project: 030185.04 EEAP BOILER-CHILLER STUDY Location: FT. SAM HOUSTON - SAN ANTONIO, TX. Client: CORPS. OF ENGINEERS - FORT WORTH, TX.

Program User: HUITT-ZOLLARS INC.

Comments: AREA 100

----- Load Section Alternative #1 -----

Card 19- Load Alternative Number Description
1 EXISTING BUILDINGS

Card 20------ General Room Parameters -----Zone Acoustic Floor to Duplicate Duplicate Perimeter Reference Room Floor Room Floor Const Plenum Ceiling Floor Floors Rooms per Depth Number Number Descrip Length Width Type Height Resistance Height Multiplier Zone 5 5 BLDG 122 113 113 3 3 2.54 11 10 10 BLDG 124 113 113 3 3 2.54 11 15 BLDG 128 15 119 119 3 8 2.54 18 20 20 BLDG 133 100 96 3 2.54 18 25 25 BLDG 134 102 102 3 3 2.54 12 122 30 30 BLDG 143 122 3 3 2.54 12 35 35 **BLDG 144** 122 122 3 3 2.54 12 40 BLDG 145 122 122 40 3 3 2.54 12 45 45 BLDG 146 122 122 3 3 2.54 12 50 50 **BLDG 147** 122 122 3 3 2.54 12 55 55 BLDG 149 122 122 3 3 2.54 12 122 60 60 BLDG 197 122 3 3 2.54 12 65 65 **BLDG 198** 68 68 3 2.54 5 14 80 70 70 BLDG 199 80 3 2.54 12 50 26 3 50 26 3 50 26 3 75 75 BLDG 125 5 2.54 15 80 80 **BLDG 127** 2.54 15 85 85 **BLDG 135** 2.54 15

Card 20				Gener	al Room	Paramete	rs				
	Zone						Acoustic	Floor to	Duplicate	Duplicate	Perimeter
Room	Reference	Room	Floor	Floor	Const	Plenum	Ceiling	Floor	Floors	Rooms per	Depth
Number	Number	Descrip	Length	Width	Type	Height	Resistance	Height	Multiplier	Zone	
90	90	BLDG 250-1	142	34	3	2	2.54	10.5			
95	95	BLDG 250-2	195	195	3	2	2.54	10.5			
100	100	BLDG. 142	65	65	3	2	2.54	10	1	1	

	Cooling	Room	Cooling	Cooling	Heating	Heating	Heating	T'stat	Mass /	Carpet
Room	Room	Design	T'stat	T'stat	Room	T'stat	T'stat	Location	No. Hrs	On
lumber	Design DB	RH	Driftpoint	Schedule	Design DB	Driftpoint	Schedule	Flag	Average	Floor
5	78	50	78		70	70		ROOM	LIGHT30	NO
10	78	50	78		70	70		ROOM	LIGHT30	NO
15	78	50	78		70	70		ROOM	LIGHT30	NO
20	78	50	78		70	70		ROOM	LIGHT30	NO
25	78	50	78		70	70		ROOM	L1GHT30	NO
30	78	50	78		70	70		ROOM	LIGHT30	NO
35	78	50	78		70	70		ROOM	LIGHT30	NO
40	78	50	78		70	70		ROOM	LIGHT30	NO
45	78	50	78		70	70		ROOM	LIGHT30	NO
50	78	50	78		70	70		ROOM	LIGHT30	NO
55	78	50	78		70	70		ROOM	LIGHT30	NO
60	78	50	78		70	70		ROOM	LIGHT30	NO
65	78	50	78		70	70		ROOH	LIGHT30	NO
70	78	50	78		70	70		ROOM	LIGHT30	NO
75	78	50	78		70	70		ROOM	LIGHT30	NO
80	78	50	78		70	70		ROOM	LIGHT30	NO
85	78	50	78		70	70		ROOM	LIGHT30	NO
90	78	50	78		70	70		ROOM	LIGHT30	NO
95	78	50	78		70	70		ROOM	LIGHT30	NO
100	78	50	78		70	70		ROOM	LIGHT30	YES

Card 22	!			Roof Par	ameters	• • • • • • • •			• • • • • •
		Roof							
Room	Roof	Equal to	Roof	Roof	Roof	Const	Roof	Roof	Roof
Number	Number	Floor?	Length	Width	U-Value	Type	Direction	Tilt	Alpha
5	1	NO	180	30	.08	37	0	60	.9
10	1	NO	180	30	.08	37	0	60	.9
15	1	YES			.08	37	0	60	.9
20	1	YES			.08	37	0	60	.9
25	1	NO	73	74	.05	40	0	45	.9
30	1	NO	146	28	.05	40	0	80	.9
35	1	NO	146	28	.05	40	0	80	.9
40	1	NO	146	28	.05	40	0	80	.9
45	1	NO	146	28	.05	40	0	80	.9
50	1	NO	146	28	.05	40	0	80	.9

Card 22				Roof Par	ameters				
		Roof							
Room	Roof	Equal to	Roof	Roof	Roof	Const	Roof	Roof	Roof
Number	Number	Floor?	Length	Width	U-Value	Type	Direction	Tilt	Alpha
55	1	NO	146	28	.05	40	0	80	.9
60	1	NO	146	28	.05	40	0	80	.9
65	1	NO	39	39	.08	37	0	60	.9
70	1	NO	56	57	.05	37	0	60	.9
75	1	YES			.08	37	0	60	.9
80	1	YES			.08	37	0	60	.9
85	1	YES			.08	37	0	60	.9
90	1	YES			.06	23	Ō	90	.9
95	1	NO	113	113	.06	23	0	90	.9
100	1	NO	47	33	0.05	40	0	80	.9

					Wall				Ground
Room	Wall	Wall	Wali	Wall	Constuc	Wall	Wall	Wali	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
5 .	1	360	11	.17	58	330	0	.74	1
5	2	60	11	.17	58	60	Ō	.74	1
5	3	360	11	.17	58	150	0	.74	1
5	4	60	11	.17	58	240	0	.74	1
10	1	360	11	.17	58	315	0	.74	1
10	2	60	11	.17	58	45	0	.74	1
10	3	360	11	.17	58	135	0	.74	1
10	4	60	11	.17	58	225	0	.74	1
15	1	100	18	.10	58	315	0	.9	1
15	2	96	18	.10	58	45	0	.9	1
15	3	100	18	.10	52	135	0	.9	1
15	4	96	18	.10	58	225	0	.9	1
20	1	100	18	.10	58	330	Ō	.9	1
20	2	96	18	.10	58	60	0	.9	1
20	3	100	18	.10	52	150	0	.9	1
20	4	96	18	.10	58	240	0	.9	1
25	1	280	12	.11	88	315	0	.9	1
25	2	60	12	.11	88	45	0	.9	1
25	3	280	12	.11	88	135	O	.9	1
25	4	60	12	.11	88	225	0	.9	1
30	1	292	12	.10	58	0	0	.9	1
30	2	56	12	.10	58	90	0	.9	1
30	3	292	12	.10	58	180	0	.9	1
30	4	56	12	.10	58	270	0	.9	1
35	1	292	12	.10	58	0	0	.9	1
35	2	56	12	.10	58	90	0	.9	1
35	3	292	12	.10	58	180	0	.9	1
35	4	56	12	.10	58	270	0	.9	1
40	1	292	12	.10	58	0	0	.9	1
40	2	56	12	.10	58	90	0	.9	1

Card 24	,			··· Wall P	arameters				
					Wall				Ground
Room	Wall	Wall	Wali	Wall	Constuc		Wall	Wall	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
40	3	292	12	.10	58	180	0	.9	1
40	4	56	12	.10	58	270	0	.9	1
45	1	292	12	.10	58	0	0	.9	1
45	2	56	12	.10	58	90	0	.9	1
45	3	292	12	.10	58	180	0	.9	1
. 45	4	56	12	.10	58	270	0	.9	1
50	1	292	12	.10	58	90	0	.9	1
50	2	56	12	.10	58	180	0	.9	1
50	3	292	12	.10	58	270	0	.9	1
50	4	56	12	.10	58	0	0	.9	1
55	1	292	12	.10	58	90	0	.9	1
55	2	56	12	.10	58	180	0	.9	1
55	3	292	12	.10	58	270	0	.9	1
55	4	56	12	.10	58	0	0	.9	1
60	1	292	12	.10	58	320	0	.9	1
60	2	56	12	.10	58	50	0	.9	1
60	3	292	12	.10	58	140	0	.9	1
60	4	56	12	.10	58	230	0	.9	1
65	1	27.5	14	.12	74	0	0	.74	1
65	2	59	14	.12	74	90	0	.74	1
65	3	27.5	14	.12	74	180	0	.74	1
65	4	59	14	.12	74	270	0	.74	1
70	1	126	12	.12	74	315	0	.74	1
70	2	31	12	.12	74	45	0	.74	1
70	3	126	12	.12	74	135	0	.74	1
70	4	31	12	.12	74	225	0	.74	1
75	1	50	15	.17	58	315	0	.74	1
75	2	26	15	.17	58	45	0	.74	1
75	3	50	15	.17	58	135	0	.74	1
75	4	26	15	.17	58	225	0	.74	1
80	1	50	15	.17	58	315	0	.74	1
80	2	26	15	.17	58	45	0	.74	1
80	3	50	15	.17	58	135	0	.74	1
80	4	26	15	.17	58	225	0	.74	1
85	1	50	15	.17	58	315	0	.74	1
85	2	26	15	.17	58	45	0	.74	1
85	3	50	15	.17	58	135	0	.74	1
85	4	26	15	.17	58	225	0	.74	1
90	1	142	10.5	.12	74	0	0	.74	1
90	2	58	10.5	.12	74	90	0	.74	1
90	3	52	10.5	.12	74	180	0	.74	1
90	4	58	10.5	.12	74	270	0	.74	1
95	1	20	10.5	.12	74	0	0	.74	1
95	2	798	10.5	.12	74	90	0	.74	1
95	3	60	10.5	.12	74	180	0	.74	1
95	4	798	10.5	.12	74	270	0	.74	1
100	1	118	10	.16	64	0	0	.74	1

Card 2				Wall P	arameters				
					Wall				Ground
Room	Wall	Wall	Wall	Wall	Constuc	Wall	Wall	Wall	Reflectance
Number	Number	Length	Height	U-Value	Type	Direction	Tilt	Alpha	Multiplier
100	2	83	10	.16	64	0	0	.74	1
100	3	118	10	.16	64	0	0	.74	1
100	4	83	10	.16	64	0	0	.74	1

				Pct Glass			External	Internal	Percent		Inside
com	Wall	Glass	Glass	or No. of	Glass	Shading	Shading	Shading	Solar to	Visible	Visible
umber	Number	Length	Width	Windows	U-Value	Coefficient	Type	Type	Ret. Air	Transmittance	Reflectanc
	1	5	3	34	1.1	.67					
	2	5	3	6	1.1	.67					
i	3	5	3	34	1.1	.67	3				
	4	5	3	6	1.1	. 67					
0	1	5	3	34	1.1	.67					
10	2	5	3	6	1.1	.67					
10	3	5	3	34	1.1	.67	3				
10	4	5	3	6	1.1	.67					
15	1	7	3	8	1.1	.67					
15	2	7	3	7	1.1	.67					
15	3	7	3	9	1.1	.67					
15	4	7	3	7	1.1	.67					
20	1	7	3	8	1.1	.67					
20	2	7	3	7	1.1	.67					
20	3	7	3	9	1.1	.67					
20	4	7	3	7	1.1	.67					
25	1	6	3	26	.8	.67					
25	2	6	3	5	.8	.67					
25	3			29	.53	1					
25	4	6	3	5	.8	.67					
30	1	7	3.5	21	1.1	.67	3				
30	2	7	3.5	6	1.1	.67					
30	3			35	1.1	.67	3				
30	4	7	3.5	6	1.1	.67					
35	1	7	3.5	21	1.1	.67	3				
35	2	7	3.5	6	1.1	.67					
35	3			35	1.1	.67	3				
35	4	7	3.5	6	1.1	.67					
40	1	7	3.5	21	1.1	.67	3				
40	2	7	3.5	6	1.1	.67					
40	3			35	1.1	.67	3				
40	4	7	3.5	6	1.1	.67					
45	1	7	3.5	21	1.1	.67	3				
45	2	7	3.5	6	1.1	.67					
45	3			35	1.1	.67	3				
45	4	7	3.5	6	1.1	.67					
50	1	7	3.5	21	1.1	.67	3				

				Pct Glass			External	Internal	Percent		Inside
Room	Wall	Glass	Glass	or No. of	Glass	Shading	Shading	Shading	Solar to	Visible	Visible
Number	Number	Length	Width	Windows	U-Value	Coefficient	Type	Type	Ret. Air	Transmittance	Reflectance
50	2	7	3.5	6	1.1	.67					
50	3			35	1.1	.67	3				
50	4	7	3.5	6	1.1	.67					
55	1	7	3.5	21	1.1	.67	3				
55	2	7	3.5	6	1.1	.67					
55	3			35	1.1	.67	3				
55	4	7	3.5	6	1.1	.67					
60	1	7	3.5	21	1.1	.67	3				
60	2	7	3.5	6	1.1	.67					
60	3			35	1.1	.67	3				
60	4	7	3.5	6	1.1	.67					
65	1	5	3	6	1.1	.67					
65	2	5	3	11	1.1	.67	3				
65	3	5	3	6	1.1	.67					
65	4	5	3	11	1.1	.67	3				
70	1	5	3	10	1.1	.67	3				
70	2	5	3	2	1.1	.67					
70	3	5	3	10	1.1	.67					
70	4	5	3	2	1.1	.67					
75	1	8	3	4	.73	.67					
75	2	8	3	2	.73	.67					
75	3	8	3	4	.73	.67					
75	4	8	3	2	.73	.67					
80	1	8	3	4	.73	.67					
80	2	8	3	2	.73	.67					
80	3	8	3	4	.73	.67					
80	4	8	3	2	.73	.67					
85	1	8	3	4	.73	.67					
85	2	8	3	2	.73	.67					
85	3	8	3	4	.73	.67					
85	4	8	3	2	.73	.67					
90	1	4	2	3	1.1	1					
90	3	7	5	3	1.1	1					
90	4	7	5	3	1.1	1					
95	2	4	2	114	1.1	.67					
95	3	4	2	6	1.1	.67					
95	4	4	2	114	1.1	.67					
100	1	5	3.5	5	1.1	0.67					
100	2	5	3.5	6	1.1	0.67					
100	3	5	3.5	7	1.1	0.67					
100	4	5	3.5	6	1.1	0.67					

Card 26				\$	chedules -				•••••	
Room					Reheat	Cooling	Heating	Auxiliary	Room	Daylighting
Number	People	Lights	Ventilation	Infiltration	Minimum	Fans	Fan	Fan	Exhaust	Controls
5	FSHOFFIC	FSHOFFIC								

Card 26				\$	ichedul es	• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •		•••••	•••••
Room					Reheat	Cooling	Heating	Auxiliary	Room	Daylighting
Number	People	Lights	Ventilation	Infiltration	Minimum	Fans	Fan	Fan	Exhaust	Controls
10	FSHOFFIC	FSHOFFIC								
15	FSHOFFIC	FSHOFFIC								
20	FSHOFFIC	FSHOFFIC								
25	FSHOFFIC	FSHOFFIC								
30	FSHOFFIC	FSHOFFIC								
35	FSHOFFIC	FSHOFFIC								
40	FSHOFFIC	FSHOFFIC								
45	FSHOFFIC	FSHOFFIC								
50	FSHBARRP	FSHBARRL								
55	FSHBARRP	FSHBARRL								
60	FSHOFFIC	FSHOFFIC								
65	FSHOFFIC	FSHOFF1C								
70	FSHOFFIC	FSHOFFIC								
75	FSHOFFIC	FSHOFFIC								
80	FSHOFFIC	FSHOFFIC								
85	FSHOFFIC	FSHOFF1C								
90	FSHOFFIC	FSHOFFIC								
95	FSHBARRP	FSHBARRP								
100	FSHOFFIC	FSHOFFIC								

							Lighting		Percent	Daylig	ghting	
Room	People	People	People	People	Lighting	Lighting	Fixture	Ballast	Lights to	Reference	Reference	
Number	Value	Units	Sensible	Latent	Value	Units	Type	Factor	Ret. Air	Point 1	Point 2	
5	60	PEOPLE	250	200	2	WATT-SF	ASHRAE2	1				
10	60	PEOPLE	250	200	2	WATT-SF	ASHRAE2	1				
15	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1				
20	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1				
25	175	SF-PERS	250	200	2.25	WATT-SF	ASHRAE2	1				
30	175	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1				
35	175	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1				
40	175	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1				
45	175	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1				
50	45	PEOPLE	250	200	1.5	WATT-SF	ASHRAE2	1				
55	45	PEOPLE	250	200	1.5	WATT-SF	ASHRAE2	1				
60	250	SF-PERS	250	200	3	WATT-SF	ASHRAEZ	1				
65	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1				
70	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1				
75	100	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1				
80	100	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1				
85	100	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1				
90	160	SF-PERS	250	200	2	WATT-SF	INCAND	1				
95	160	SF-PERS	250	200	1.5	WATT-SF	INCAND	1				
100	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1				

Card 28				Mis	cellaneous	Equipment				••••••	
	Misc		Energy	Energy		Energy	Percent	Percent	Percent		
Room	Equipment	Equipment	Consump	Consump	Schedul e	Meter	of Load	Misc. Load	Misc. Sens	Radiant	Optional
Number	Number	Descrip	Value	Units	Code	Code	Sensible	to Room	to Ret. Air	Fraction	Air Path
5	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
10	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
15	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
20	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
25	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
30	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
35	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
40	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
45	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
50	1	T.VETC.	1	WATT-SF	FSHBARRL	NONE	100	100			
55	1	T.VETC.	1	WATT-SF	FSHBARRL	NONE	100	100			
60	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
65	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
70	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
75	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
80	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
85	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
90	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
95	1	COMPUTER	1	WATT-SF	FSHBARRL	NONE	100	100			
100	1	COMPUTERS	1	WATT-SF	FSHOFFIC	NONE	100	100			

		Venti	lation		• • • • • • • • • • • • • • • • • • • •	Infiltration							
Room	Cooling		Heating		Cooling		Heating		Reheat Minimum-				
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units			
5	20	CFM-P	20	CFM-P									
10	20	CFM-P	20	CFM-P									
15	20	CFM-P	20	CFM-P									
20	20	CFM-P	20	CFM-P									
25	20	CFM-P	20	CFM-P									
30	20	CFM-P	20	CFM-P									
35	20	CFM-P	20	CFM-P									
40	20	CFM-P	20	CFM-P									
45	20	CFM-P	20	CFM-P									
50	15	CFM-P	15	CFM-P									
55	15	CFM-P	15	CFM-P									
60	20	CFM-P	20	CFM-P									
65	20	CFM-P	20	CFM-P									
70	20	CFM-P	20	CFM-P									
75	20	CFM-P	20	CFM-P									
80	20	CFM-P	20	CFM-P									
85	20	CFM-P	20	CFM-P									
90	20	CFM-P	20	CFM-P									
95	20	CFM-P	20	CFM-P									
100	20	CFM-P	20	CFM-P									

	Exposed	Slab-					xposed Flo	юг		
Room	Floor	Perimeter	Loss	Floor	Floor	Const	Temp	Cooling	Heating	Adjacen
Number	Number	Length	Coefficient	Area	U-Value	Type	Flag	Temp	Temp	Room No
5	1			5400	.19	119	HRLYOADB			
10	1			5400	.19	119	HRLYOADB			
15	1			14224	.19	119	HRLYOADB			
20	1			9600	.19	119	HRLYOADB			
50	1			5400	.19	119	HRLYOADB			
55	1			5400	.19	119	HRLYOADB			
70	1			3906	.25	119	HRLYOADB			

		OVERHA	NG	• • • • • •		VERTICAL F	INS		
		Height				Left		Right	Adjacent
Shading	Glass	Above	Projection	Glass	Projection	Projection	Projection	Projection	Building
Туре	Height	Glass	Out	Width	Left	Out	Right	Out	Flag
3	5	2	8						

Card 39- System Alternative Number Description

1 AREA 100 EXISTING SYSTEMS

Set System Deck Cooling Heating Cooling Heating Static Number Type Location SADBVh SADBVh Schedule Schedule Pressur 1 MZ 2 MZ 3 MZ 4 MZ 5 MZ 6 MZ 7 MZ 8 MZ 9 MZ					AL VENIIL	ATION SYST	EM	
Number Type	System		Ventil					Fan
1 MZ 2 MZ 3 MZ 4 MZ 5 MZ 6 MZ 7 MZ 8 MZ 9 MZ 10 MZ 11 MZ 12 MZ 13 MZ	Set	System	Deck	Cooling	Heating	Cooling	Heating	Static
2 MZ 3 MZ 4 MZ 5 MZ 6 MZ 7 MZ 8 MZ 9 MZ 10 MZ 11 MZ 12 MZ 13 MZ	Number	Type	Location	SADBVh	SADBVh	Schedul e	Schedule	Pressure
3 MZ 4 MZ 5 MZ 6 MZ 7 MZ 8 MZ 9 MZ 10 MZ 11 MZ 12 MZ 13 MZ	1	MZ						
4 MZ 5 MZ 6 MZ 7 MZ 8 MZ 9 MZ 10 MZ 11 MZ 12 MZ 13 MZ	2	MZ						
5 MZ 6 MZ 7 MZ 8 MZ 9 MZ 10 MZ 11 MZ 12 MZ 13 MZ	3	MZ						
6 MZ 7 MZ 8 MZ 9 MZ 10 MZ 11 MZ 12 MZ 13 MZ	4	MZ						
7 NZ 8 NZ 9 NZ 10 NZ 11 MZ 12 NZ 13 NZ 14 NZ	5	MZ						
8 MZ 9 MZ 10 MZ 11 MZ 12 MZ 13 MZ 14 MZ	6	MZ						
9 MZ 10 MZ 11 MZ 12 MZ 13 MZ 14 MZ	7	MZ						
10 MZ 11 MZ 12 MZ 13 MZ 14 MZ	8	MZ						
11 MZ 12 MZ 13 MZ 14 MZ	9	MZ						
12 MZ 13 MZ 14 MZ	10	MZ						
13 MZ 14 MZ	11	MZ						
14 MZ	12	MZ						
	13	MZ						
15 MZ	14	HZ						
	15	MZ						
		Ť						

----- System Section Alternative #1 ------

			OPTION	AL VENTIL	ATION SYST	EM	
System		Ventil					Fan
Set	System	Deck	Cooling	Heating	Cooling	Heating	Static
Number	Туре	Location	SADBVh	SADBVh	Schedule	Schedule	Pressure
16	MZ						
17	MZ						
18	MZ						
19	MZ						
20	SZ						

System Set	Ref	#1	Ref	#2	Ref	#3	Ref	#4	Ref	#5	Ref	#6
Number	Begin	End	Begin		Begin			End		End	Begin	Enc
1	5	5									•	
2	10	10										
3	15	15										
4	20	20										
5	25	25										
6	30	30										
7	35	35										
8	40	40										
9	45	45										
10	50	50										
11	55	55										
12	60	60										
13	65	65										
14	70	70										
15	75	75										
16	80	80										
17	85	85										
18	90	90										
19	95	95										
20	100	100										

System	Cool	Heat	Return	Mn Exh	Aux	Rm Exh	Cool	Return	Supply	Supply	Return
Set	Fan	Fan	Fan	Fan	Fan	Fan	Fan Mtr	Fan Mtr	Duct	Duct	Air
Number	SP	SP	SP	SP	SP	SP	Loc	Loc	Ht Gn	Loc	Path
1	1										
2	1										
3	2.25										
4	2.25										
5	1.5										
6	1.4										
7	1.4										

Card 42		•••••		Fan	SP ar	nd Duct P	arameters				
System	Cool	Heat	Return	Mn Exh	Aux	Rm Exh	Cool	Return	Supply	Supply	Return
Set	Fan	Fan	Fan	Fan	Fan	Fan	Fan Mtr	Fan Mtr	Duct	Duct	Air
Number	SP	SP	SP	SP	SP	SP	Loc	Loc	Ht Gn	Loc	Path
8	.5										
9	1.4										
10	1.4										
11	1.4										
12	1.4										
13	1.5										
14	1.5										
15	1										
16	1										
17	1										
18	2.5										
19	2.5										
20	1.0	1.0									

System	Main		Direct	Indirect	Auxiliary	Main	Main			Auxiliar
Set	Cooling		Evap	Evap	Cooling	Heating	Preheat	Reheat	Mech.	Heating
Number	Coil	Economizer	Coil	Coil	Coil	Coil	Coil	Coil	Humidity	Coil
1	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
2	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
3	OFF					OFF	OFF	OFF		
4	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
5	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
6	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
7	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
8	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
9	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
10	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
11	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
12	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
13	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
14	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
15	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
16	FTSAHCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
17	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
18	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
19	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
20	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		

----- Equipment Section Alternative #1 -----

B-131

16 100ACREC 1

17 100ACREC 1

100 TONS

10 TONS

176

17.6 KW

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Card 59----- Equipment Description / TOD Schedules -----
                   Elec Consump Elec Demand Demand
                                                                                                                                        ---- Demand Limit ---
Alternative Time of Day Time of Day Limit
                                                                                                                                              Temperature
                                       Schedule Max KW Alternative Description Schedule Drift
Number
                   Schedule
                                                                         BASE CASE
Card 60----- Cooling Load Assignment-----
Load All Coil Cooling
Asgn Loads To Equipment -Group 1- -Group 2- -Group 3- -Group 5- -Group 6- -Group 7- -Group 8- -Group 9-
Ref Cool Ref Sizing Begin End Begin 
                        BLKPLANT 2
                                               2 15 15
                        BLKPLANT 3
3
      3
                                               3
                        BLKPLANT 4
                                                  5 17 17
5
       5
                        BLKPLANT 5
                       BLKPLANT 6
6
       6
                                                6
7
                      BLKPLANT 7
      9
                       BLKPLANT B
я
                                                  8
9
         10
                       BLKPLANT 9
10 11
                      BLKPLANT 10
                                                 11
11 12
                     BLKPLANT 12 12
12 13
                     BLKPLANT 13 13
      14
                       BLKPLANT 14
13
                                                  14
14
        15
                         BLKPLANT 16
                                                   16
                         BLKPLANT 18
15 16
                                                  19
16 17
                         BLKPLANT 20
                                                   20
Card 62----- Cooling Equipment Parameters ------
 Ref Code
                                                                                          --Capacity-- ----Energy---- Order Seq Limit
Value Units Value Units Num Type Number
                      Of --Capacity-- ----Energy----
                                                            Value Units
70.4 KW
 Num Name
                      Units Value Units
       100ACREC 1 40 TONS
       100ACREC 1
                             50 TONS
                                                        88
                                                                           KW
 3
       100ACREC 1
                             40 TONS
                                                       70.4 KU
                             25
        100ACREC 1
                                            TONS
                                                              44
                                                                           KW
                                                             52.8 KW
 5
        100ACREC 1
                                 30
                                            TONS
                              45 TONS
       100ACREC 1
                                                             79.2 KW
 6
       100ACREC 1
                             45 TONS
                                                             79.2
                                                                            KW
                                                                                                                                                                 PAR
      EQ1161 1
                             4
                                                             5.81
                                                                                                                                                                 PAR
                                             TONS
 В
                                                                           KU
        E91161
                                 46
                                             TONS
                                                              67.6
                                                                           KW
                             40
 10 100ACREC 1
                                                              70.4 KW
                                             TONS
 11 100ACREC 1
                             50
                                            TONS
                                                             88 KW
 12 100ACREC 1
                             50 TONS
                                                              88
                                                                           KW
 13 100ACREC 1
                             10
                                            TONS
                                                             17.6 KW
 14 100ACREC 1
                                 15
                                             TONS
                                                              26.4
                                                                           KW
                                                              8.48 KW
 15 Eq1161 1
                                 4.5
                                            TONS
```

Card	63			Cooling Pu	mps and Ref	erences	• • • • • • • • • • • • • • • • • • • •			• • • • • •
Cool	CHILLED	WATER	CONDE	NSER	HT REC	or AUX	Switch-			
Ref	Full Load	Full Load	Full Load	Full Load	Full Load	Full Load	over	Cold	Cooling	Misc.
Num	Value	Units	Value	Units	Value	Units	Control	Storage	Tower	Access.
1	2.24	KW								3
2	2.24	KW								5
3	1.12	KW								
4	1.12	KW								
5	.37	KW								
6	2.24	KW								
7	2.24	KW								
10	1.12	KW								
11	3.73	KW								
12	1.49	KW								
13	1.12	KW								
14	1.49	KW								
16	5.6	KW								
17	.75	KW								

Card 65			••••			Heating	Load Assign	ment				
Load	All Coil											
Assignment	Loads To	-Grou	ap 1-	-Grou	p 2-	-Group 3-	-Group 4-	-Group 5-	-Group 6-	-Group 7-	-Group 8-	-Group 9-
Reference	Heating Ref	Begir	End	Begir	End	Begin End	Begin End	Begin End	Begin End	Begin End	Begin End	Begin End
1	1	1	1									
2	2	2	2	15	15							
3	3	3	3									
4	4	4	4									
5	5	5	5	17	17							
6	6	6	6									
7	7	7	7									
8	8	8	8									
9	9	9	9									
10	10	10	10									
11	11	11	11									
12	12	12	12									
13	13	13	13									
14	14	14	14									
15	15	16	16									
16	16	18	19									
17	18	20	20									

Card 67	7				Hea	iting Equi	ipment Pa	rameters ·	• • • • • • • • • • • • • • • • • • • •					
Heat	Equip	Number	HW Pmp				Energy		Seq	Switch				Demand
Ref	Code	Of	Full Ld		Cap'y		Rate		Order	over	Hot	Misc.		Limit
Number	Name	Units	Value	Units	Value	Units	Value	Units	Number	Control	Strg	Acc.	Cogen	Number
1	BOILERWT	1	1.12	KW	618	MBH	850	HBH				2		
2	BOILERWT	1	1.12	KW	618	MBH	850	MBH				Z		
3	BOILERUT	1	0.37	KW	109	MBH	150	MBH						
4	BOILERUT	1	.37	KW	109	MBH	150	MBH				1		
5	BOILERWT	1	.37	KW	596	MBH	820	MBH						

Card 67					Hea	ting Equip	ment Par	ameters	• • • • • • • • • • • • • • • • • • • •					
Heat	Equip	Number	HW Pmp				Energy		Seq	Switch				Demand
Ref	Code	Of	Full Ld		Cap'y		Rate		Order	over	Hot	Misc.		Limit
Number	Name	Units	Value	Units	Value	Units	Value	Units	Number	Control	Strg	Acc.	Cogen	Number
6	BOILERWT	1	.75	KW	596	MBH	820	MBH						
7	BOILERWT	1	.75	KW	596	HBH	820	MBH						
8	E92454	1			515.2	MBH	53.59	KW						
9	BOILERWT	1	.75	KW	596	MBH	820	MBH						
10	BOILERWT	1	.75	KW	596	MBH	820	MBH						
11	BOILERWT	1	.75	KW	596	MBH	820	MBH						
12	BOILERWT	1	.75	KW	1273	MBH	1750	MBH						
13	BOILERWT	1	.56	KW	327	MBH	450	MBH						
14	BOILERWT	1	1.12	KW	145	MBH	200	MBH						
15	EQ2454	1			33	MBH	45	MBH						
16	STEAMBLR	1			727	MBH	1000	MBH	1					
17	STEAMBLR	1			727	MBH	1000	MBH	2					
18	BOILERWT	1	.37	KW	327	MBH	450	MBH						

Card 71-			Base	Utility Pa	arameters				•••••
Base	Base	Hourly	Hourly			Equip	Demand		
Utility	Utility	Demand	Demand	Schedul e	Energy	Reference	Limiting	Entering	Leaving
Number	Descrip	Value	Units	Code	Туре	Number	Number	Temp	Temp
1	PIPE-PUMP HT LOS	1.2	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE HT LOS	10.98	MBH	FTSAMHTG	HOT-LD	1			
3	PIPE-PUMP HT LOS	1.32	TONS	FTSAMCLG	CHILL-LD	2			
4	PIPE HT LOSS	12.81	MBH	FTSAMHTG	HOT-LD	2			
5	PIPE-PUMP HT LOS	1.03	TONS	FTSAMCLG	CHILL-LD	3			
6	PIPE HT LOSS	13.64	MBH	FTSAMHTG	HOT-LD	3			
7	PIPE-PUMP HT LOS	.83	TONS	FTSAMCLG	CHILL-LD	4			
8	PIPE HT LOSS	10.14	MBH	FTSAMHTG	HOT-LD	4			
9	PIPE-PUMP HT LOS	.89	TONS	FTSAMCLG	CHILL-LD	5			
10	PIPE HT LOSS	6.67	MBH	FTSAMHTG	HOT-LD	5			
11	PIPE-PUMP HT LOS	1.4	TONS	FTSAMCLG	CHILL-LD	6			
12	PIPE HT LOS	10.21	MBH	FTSAMHTG	HOT-LD	6			
13	PIPE-PUMP HT LOS	1.4	TONS	FTSAMCLG	CHILL-LD	7			
14	PIPE HT LOSS	10.21	MBH	FTSAMHTG	HOT-LD	7			
15	COMPR HEAT	1.5	TONS	FTSAMCLG	CHILL-LD	9			
16	REFRIG. HT LOSS	10.2	MBH	FTSAMHTG	HOT-LD	8			
17	PIPE-PUMP HT LOS	1.09	TONS	FTSAMCLG	CHILL-LD	10			
18	PIPE HT LOSS	10.21	MBH	FTSAMHTG	HOT-LD	9			
19	PIPE-PUMP HT LOS	1.98	TONS		CHILL-LD	11			
20	PIPE HT LOSS	10.07	MBH	FTSAMHTG		10			
21	PIPE NT LOSS	10.07	МВН	FTSAMHTG		11			
22	PIPE-PUMP HT LOS	1.14	TONS		CHILL-LD				,
23	PIPE HT LOSS	9.12	МВН	FTSAMHTG		12			
24	PIPE-PUMP HT LOS	.53	TONS		CHILL-LD	13			
25	PIPE HT LOSS	3.03	мвн	FTSAMHTG		13			
26	PIPE-PUMP HT LOS	0.72	TONS		CHILL-LD				
27	PIPE HT LOSS	5.5	MBH	FTSAMHTG		14			
						• •			

Card 71														
Base	Base		Hou	ty Hou	ırly			Equi	р	Demand				
Jtility	/ Utili	ty	Dema	and Der	nand So	chedul e	Energy	Refe	rence	Limiting	Entering	Leav	ing	
lumber	Descr	ip	Valu	ue Uni	its Co	ode	Type	Numb	er	Number	Temp	Temp		
28	PIPE	HT LOSS	.11			TSAMCLG		.D 15						
29	PIPE	HT LOSS	1.83	S MBI	f F1	TSAMHTG	HOT-LD	15						
30	PIPE-	PUMP HT LC	os 3	TO		TSAMCLG		.D 16						
31	PIPE	HT LOSS	22.8	B MBI	l F	TSAMHTG	HOT-LD	16						
32		PUMP HT LO				TSAMCLG								
33	PIPE	HT LOSS	3.3	2 M 81	ł F	TSAMHTG	HOT-LD	18						
Card 75	5				н	iscellan	eous Acc	essory						••••
	#1				#2			•		#3				
Misc E		Energy	Energy	Sched	Equi	p En	ergy	Energy	Sched		Ene	rgy	Energy	Sched
	Code	Value	Units	Code	Code	-		Units					Units	
	EQ5240	3.73	KW											
	E95020	1.12	KW											
3 (EQ5001	2.24	KW											
4 1	EQ5020	1.12	KW											
5 .0	E95001	2.24	KW											
		E	quipment	Section	Alterna	itive #2	******	•••••	•••••					
	9	Etec Consu		Equi	pment D							Demand	Limit -	
Card 5	9		mp Elec	Equi Demand D of Day L	pment D emand imit	escripti)	ion / TO	D Sched	ıles		••••	Demand Te	Limit - emperatu	
Card 5	9 ! wative 1	Elec Consu	mp Elec y Time	Equi Demand D of Day L	pment D emand imit ax KW	escripti Alternat	ion / TO	D Sched	ules			Demand Te	Limit -	
Card 5 Altern Number	9 ! wative 1	Elec Consu Time of Da	mp Elec y Time	Equi Demand D of Day L	pment D emand imit ax KW	escripti)	ion / TO	D Sched	ules		••••	Demand Te	Limit - emperatu	
Card 5 Altern Number 2 Card 6	9 Enative 1	Elec Consu Time of Da Schedule	mp Elec y Time Sched	Equi Demand D of Day L Jule M	pment D emand imit ax KW	Descripti Alternat AIR COOL	ion / TO tive Des LED SING	D Schedi criptio	ules n # CHILL	.ERS	Sched	Demand Te Jule	Limit - emperatu Drift	 ire
Card 5 Altern Number 2 Card 6 Load	9 lative 1	Elec Consu Time of Da Schedule	mp Elec y Time Sched	Equi Demand D of Day L Jule M	pment D emand imit ax KW	Alternat AIR COOL	ion / TO tive Des LED SING	D Schede cription LE SCRE	ules n d CHILL ment	ERS	Sched	Demand Te Jule	Limit - emperatu Drift	ire
Card 5 Altern Number 2 Card 6 Load Asgn	9 lative 1 5 60 All Coi Loads To	Elec Consu Time of Da Schedule L Cooling O Equipme	mp Elec y Time Sched	Equi Demand D of Day L Jule M	pment D emand imit ax KW	Alternat AIR COOL Cooli	ion / TO tive Des LED SING ing Load	D Schedo cription LE SCREI Assign	ules i CHILL ment	.ERS	Sched	Demand Te ule	Limit - emperatu Drift Grou	ire ire up 8Group
Card 5 Altern Number 2 Card 6 Load Asgn Ref	9	Elec Consu Time of Da Schedule L Cooling O Equipme f Sizing	mp Elec y Time Sched	Equi Demand D of Day L Jule M M yp 1Gr n End Beg	pment D emand imit ax KW	Alternat AIR COOL Cooli	ion / TO tive Des LED SING ing Load	D Schedo cription LE SCREI Assign	ules i CHILL ment	.ERS	Sched	Demand Te ule	Limit - emperatu Drift Grou	ire
Card 5 Altern Number 2 Card 6 Load Asgn Ref	9 lative 1 5 60 All Coi Loads To	Elec Consu Time of Da Schedule L Cooling O Equipme	mp Elec y Time Sched	Equi Demand D of Day L Jule M	pment D emand imit ax KW	Alternat AIR COOL Cooli	ion / TO tive Des LED SING ing Load	D Schedo cription LE SCREI Assign	ules i CHILL ment	.ERS	Sched	Demand Te ule	Limit - emperatu Drift Grou	ire ire up 8Group
Card 5 Altern Number 2 Card 6 Load Asgn Ref 1	gative 1	Elec Consu Time of Da Schedule L Cooling O Equipme f Sizing BLKPLAN	mp Elec y Time Sched	Demand Dof Day Lule Mule Mule Mule Mule Mule Mule Mule M	pment D emand imit ax KW	Alternat AIR COOL Cooli -Group Begin E	tive Des ED SING ing Load 3Gr End Beg	D Schede cription LE SCREI Assign oup 4- in End	n de CHILL Terres de Chille Group Begin	ERS 5Gro End Begi	Sched	Demand Te lule	Limit - emperatu Drift Groud Begin	up 8Group n End Begin (
Card 5 Altern Number 2 Card 6 Load Asgn Ref 1	gative 1	Elec Consu Time of Da Schedule L Cooling O Equipme f Sizing BLKPLAN	mp Elec y Time Sched ent -Grou Begir IT 1	Demand D of Day L tule M op 1Gr n End Beg 20	pment D emand imit ax KW roup 2- in End	Alternat AIR COOL Cooli -Group Begin E	tive Des ED SING ing Load 3Gr End Beg	D Schede cription LE SCREI Assign oup 4- in End Paramet	n de CHILL ment	ERS 5Grown End Begin	Sched	Demand Telule Group 7: egin End	Limit - emperatu Drift Ground Begin	up 8Group n End Begin (
Card 5 Altern Number 2 Card 6 Load Asgn Ref 1 Card 6 Cool E	gative 1	Elec Consu Time of Da Schedule L Cooling O Equipme f Sizing BLKPLAN	mp Elec y Time Sched	Demand D of Day L tule M op 1Gr n End Beg 20	pment D emand imit ax KW roup 2- in End	Alternat AIR COOL Cooli -Group Begin E	tive Des ED SING ing Load 3Gr End Beg	D Schede cription LE SCREI Assign oup 4- in End Paramet	TO GROUP BEGIN	ERS 5 Gro End Begi	Sched	Demand Telule Group 7- Segin End Seq Ord	Limit - emperatu Drift Ground Begin	up 8Group n End Begin I
Card 5 Altern Number 2 Card 6 Load Asgn Ref 1 Card 6 Cool E Ref C Num N	9 Native 1	Elec Consu Time of Da Schedule L Cooling O Equipme f Sizing BLKPLAN	mp Elec y Time Sched ent -Grou Begin IT 1	Demand Dof Day Lule Mule Mule Mule Mule Mule Mule Mule M	pment D emand imit ax KW coup 2- in End	Alternat AIR COOL Cooli -Group Begin E	tive Des ED SING ing Load 3Gr End Beg	D Schede cription LE SCREI Assign oup 4- in End Paramet	TO GROUP BEGIN	ERS 5Grown End Begin	Sched	Demand Telule Group 7- gin End Seq Ord Num	Limit - emperatu Drift Grou d Begin	up 8Group n End Begin Demand Limit e Number
Card 5 Altern Number 2 Card 6 Load Asgn Ref 1 Card 6 Cool E Ref C Num N 1 E	gative 1	Elec Consu Time of Da Schedule L Cooling O Equipme f Sizing BLKPLAN Num - Of - Units V 1 2	mp Elec y Time Sched	Demand Dof Day Lule Mule Mule Mule Mule Mule Mule Mule M	pment D emand imit ax KW roup 2- in End	Alternat AIR COOL Cooli -Group Begin E	tive Des ED SING ing Load 3Gr End Beg	D Schede cription LE SCREI Assign oup 4- in End Paramet	TO GROUP BEGIN	ERS 5 Gro End Begi	Sched	Demand Telule Group 7- Segin End Seq Ord	Limit - emperatu Drift Ground Begin	up 8Group n End Begin Demand Limit e Number

	l Load	WATER Full Load	CONDE				Swi	tch-						
um Valu 22.3		Full Load						_		A 17				
22.3	ue								old	Cooling				
		Units	Value	Units	Value	Units	Con	ntrol S	torage		Access	S.		
22.3		KW								1				
	38	KW								1				
ard 71-	Base	••••••	Hourly	Hourly	Utility F	Parameters	Equip		nand			•-		
tility	Utility	у	Demand	Demand	Schedule	Energy	Referen	nce Lin	niting	Entering	Leavi	ng		
umber	Descri	P	Value	Units	Code	Type	Number	Nun	ber	Temp	Temp			
	PIPE-P	UMP LOSS	18.53	TONS	FTSAMCLG	CHILL-LD	1							
and 7/-				Condenser	/ Coolin	n Touer Da	rameters							
	cooling			Energy	Energy	, 10mc, 10	, and tell 3			t Low Sp		w Spd		
ower T	-	Capacity	Capacity			Fluid	Tower			w Energy		егду		
	ode	Value	Units	Value	Units	Туре	Туре			d Value		its		
	95200	Value	Dirits	0	KW	1750	175~		EUR OF		J.,	.,		
	9200			•	N=									
•••••	•••••	Equ	ipment Sect	ion Altern	native #3	•••••								
			ipment Sect	Equipment	Descript									
Card 59-	El	ec Consump		Equipment	Descript				•••••		emand L		•	
Card 59-	El tive Ti	ec Consump	Elec Dema	Equipment and Demand ay Limit	Descript		Schedule				mand L Ten	imit	•	
Card 59- Alternat Number	El tive Ti	ec Consump	Elec Dema	Equipment and Demand ay Limit	Descript Alterna	ion / 100	Schedule	s •••••		De	mand L Ten	.imit nperatur	•	
Card 59- Alternat Number 3	El tive Ti Sc	ec Consump ime of Day chedule	Elec Dema	Equipment and Demand ay Limit Max KW	Descript Alterna NATURAL	ion / 100 tive Descr DRAFT WAT	Schedule ription ER TUBE	S BOILERS		Schedul	emand L Ten	imit nperatur Drift	e	
Card 59- Alternat Number 3 Card 65- Load	El tive Ti Sc	ec Consump ime of Day chedule	Elec Dema Time of D Schedule	Equipment and Demand ay Limit Max KW	Descript Alterna NATURAL	ion / TOD tive Descr DRAFT WAT	Schedule Piption ER TUBE	BOILERS		Schedul	emand L Ten	imit nperatur Drift	e	
Card 59- Number 3 Card 65- Load Assignma	El tive Ti Sc All	ec Consump ime of Day chedule L Coil	Elec Dema Time of D Schedule	Equipment and Demand ay Limit Max KW	Descript Alterna NATURAL Heatin	ion / TOD tive Descr DRAFT WAT ig Load Ass - Group	Schedule Fiption ER TUBE Signment 4Gro	BOILERS	-Group (Schedul	Ten	imit mperatur Drift Group 8	- e 3Gr	oup 9-

Card 71-			Base	Utility P	arameters	•••••			******
Base	Base	Hourly	Hourly			Equip	Demand		
Utility	Utility	Demand	Demand	Schedule	Energy	Reference	Limiting	Entering	Leaving
Number	Descrip	Value	Units	Code	Type	Number	Number	Temp	Temp
1	PIPE HT LOSS	49.92	HBH	FTSAMHTG	HOT-LD	1			
2	PIPE HT LOSS	110.89	MBH	FTSAMHTG	HOT-LD	2			

Utility Description Reference Table

Schedules:

FSHBARRL F.S.H. BARRACKS LIGHT/MISC. SCHEDULE
FSHBARRP F.S.H. BARRACKS PEOPLE SCHEDULE
FSHOFFIC F.S.H. OFFICE INTERNAL LOAD SCHEDULE
FTSAMCLG EEAP BOILER/CHILLER STUDY
OFF ALWAYS OFF

System:

MZ MULTIZONE SZ SINGLE ZONE

Equipment:

Cooling:

100ACREC AREA 100 EXIST AIR COOLED RECIP CHILLR EQ1161 AIR COOLED COND COMP < 15 TONS EQ1510 AIR COOLED SERIES R (RTAA)

Heating:

BOILERWT WATERTUBE BOILER
EQ2454 RESIDENTIAL GAS FURNACE WITH FAN
STEAMBLE GAS FIRED STEAM BOILER
Tower:

E95200 CONDENSER FANS

Misc:

EQ5001 CHILLED WATER PUMP - CONSTANT VOLUME
EQ5020 HEATING WATER CIRCULATION PUMP
EQ5240 BOILER FORCED DRAFT FAN

> 030185.04 EEAP BOILER-CHILLER STUDY FT. SAM HOUSTON - SAN ANTONIO, TX. CORPS. OF ENGINEERS - FORT WORTH, TX. HUITT-ZOLLARS INC.

AREA 100

Weather File Code:

Enthalpy Factor:

 Location:
 SAN ANTONIO, TEXAS

 Latitude:
 29.0 (deg)

 Longitude:
 98.0 (deg)

 Time Zone:
 6

 Elevation:
 792 (ft)

 Barometric Pressure:
 29.0 (in. Hg)

Summer Clearness Number: 0.90
Winter Clearness Number: 0.90
Summer Design Dry Bulb: 97 (F)
Summer Design Wet Bulb: 76 (F)
Winter Design Dry Bulb: 30 (F)
Summer Ground Relectance: 0.20
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)
Air Specific Heat: 0.2444 (Btu/lbm/F)
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)

4.4255 (Lb-min./hr/cuft)

Design Simulation Period: June To November
System Simulation Period: January To December
Cooling Load Methodology: TETD/Time Averaging

Time/Date Program was Run: 12:36: 0 6/12/95
Dataset Name: FSH100 .TM

SYSTEM TOTALS LOAD PROFILE - ALTERNATIVE 1
AREA 100 EXISTING SYSTEMS

System Totals

Percent	Cool	ing Loa	d	Heatin	g Load	• • • • • •
Design	Cap.	Hours	Hours	Capacity	Hours	Hours
Load	(Ton)	(%)		(Btuh)	(%)	
0 - 5	25.3	8	360	-162,580	43	972
5 - 10	50.5	12	510	-325,160	29	650
10 - 15	75.8	11	495	-487,740	8	176
15 - 20	101.1	8	347	-650,319	5	106
20 - 25	126.3	7	290	-812,899	3	64
25 - 30	151.6	7	325	-975,479	3	68
30 - 35	176.9	7	298	-1,138,059	3	73
35 - 40	202.1	8	351	-1,300,639	3	62
40 - 45	227.4	7	297	-1,463,218	2	53
45 - 50	252.6	7	298	-1,625,798	1	29
50 - 55	277.9	4	194	-1,788,378	0	0
55 - 60	303.2	4	169	-1,950,958	0	0
60 - 65	328.4	3	149	-2,113,538	0	0
65 - 70	353.7	4	171	-2,276,118	0	0
70 - 75	379.0	_ 1	22	-2,438,698	0	0
75 - 80	404.2	2	86	-2,601,278	0	0
80 - 85	429.5	0	0	-2,763,858	0	0
85 - 90	454.8	0	0	-2,926,437	0	0
90 - 95	480.0	0	0	-3,089,017	0	0
95 - 100	505.3	0	0	-3,251,597	0	0
Hours Off	0.0	0	4,398	0	0	6,507

"JIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 JE CASE

f	Equip					Mor	thly Cons	sumption						
n	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	0ct	Nov	Dec	Tot
)	LIGHTS													
	ELEC	99030	89550	105452	94800	102241	101222	95819	105452	94800	102241	94800	95819	1,181,2
	PK	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK ·	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
l			BAS	SE UTILIT	Y									
	CHILLD	0	0	0	0	893	864	893	893	864	893	0	0	5,
	PK	0.0	0.0	0.0	0.0	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0	
2				SE UTILIT										
	HOTLD	82	74	82	79	0	0	0	0	0	0	79	82	
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	
5				SE UTILIT										
	CHILLD	0	0	0	0	982	950	982	982	950	982	0	0	5,
	PK	0.0	0.0	0.0	0.0	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0	
			BAS	SE UTILIT	Y									
	HOTLD	95	86	95	92	0	O	0	0	0	0	92	95	
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	

11PHENT ENERGY CONSUMPTION - ALTERNATIVE 1

lef	Equip			• • • • • • • •		Mont	hly Cons	umption						
lum	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
5			BASE	UTILITY										
	CHILLD	0	0	0	0	766	742	766	766	742	766	0	0	4,54
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
6				UTILITY										
	HOTED	101	92	101	98	0	0	0	0	0	0	98	101	593
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
7				UTILITY										
	CHILLD	0	0	0	0	618	598	618	618	598	618	0	0	3,669
	PK	0.0	0.0	0.0	0.0	8.0	8.0	0.8	0.8	0.8	0.8	0.0	0.0	0.8
8				UTILITY										
	HOTLD	75	68	75	73	0	0	0	0	0	0	73	75	44
1	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
9				UTILITY										
	CHILLD	O	0	0	0	662	641	662	662	641	662	0	0	3,93
	PK	0.0	0.0	0.0	0.0	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.
0				UTILITY										
	HOTLD	50	45	50	48	0	0	0	0	0	0	48	50	29
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
1				UTILITY										
	CHILLD	0	0	0	0	1042	1008	1042	1042	1008	1042	0	0	6,18
	PK	0.0	0.0	0.0	0.0	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0	1.
2				UTILITY										
	HOTLD	76	69	76	74	0	0	0	0	0	0	74	76	44
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
3		_		UTILITY										
	CHILLD	0	0	0	0	1042	1008	1042	1042	1008	1042	0	0	6,18
	PK	0.0	0.0	0.0	0.0	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0	1.
4				UTILITY		_								
	HOTLD	76	69	76	74	0	0	٥	0	0	0	74	76	44
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
15				UTILITY										
	CHILLD	0	0	0	0	1116	1080	1116	1116	1080	1116	0	0	6,62
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	1.

"IPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 .SE CASE

	Equip ·	Jan	Pak	W		Mont				C	0	Maria		
an.	Lode	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
6			BASE	UTILITY										
	HOTLD	76	69	76	73	0	0	0	0	0	0	73	76	44
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
7			BASE	UTILITY										
	CHILLD	0	0	0	0	811	785	811	811	785	811	0	0	4,81
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.
8			BASE	UTILITY										
	HOTED	76	69	76	74	0	0	0	0	0	0	74	76	44
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
9			BASE	UTILITY										
	CHILLD	0	0	0	0	1473	1426	1473	1473	1426	1473	0	0	8,7
	PK	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	2
0			BASE	UTILITY										
	HOTLD	75	68	75	73	0	0	0	0	0	0	73	75	4
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0
1			BASE	UTILITY										
	HOTLD	75	68	75	73	0	0	0	0	0	0	73	75	4
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0
2			BASE	UTILITY										
	CHILLD	0	0	0	0	848	821	848	848	821	848	0	0	5,0
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1
3			BASE	UTILITY										
	HOTLD	68	61	68	66	0	0	0	0	0	0	66	68	3
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0
4				UTILITY										
	CHILLD	0	0	0	0	394	382	394	394	382	394	0	0	2,3
	PK	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	O
5				UTILITY										
	HOTLD	23	20	23	22	0	0	0	0	0	0	22	23	1
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
6				UTILITY										
	CHILLD	0	0	0	0	536	518	536	536	518	536	0	0	3,
	PK	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	

"IPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 ... JE CASE

ef	Equip ·					· Mont	thly Cons	sumption						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
7			BASE	UTILITY										
	HOTLD	41	37	41	40	0	0	0	0	O	0	40	41	23
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0
3			BASE	UTILITY										
	CHILLD	0	0	0	0	82	79	82	82	79	82	0	0	44
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0
9			BASE	UTILITY										
	HOTLD	14	12	14	13	0	0	0	0	0	0	13	14	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0			BASE	UTILITY										
	CHILLD	0	0	0	0	2232	2160	2232	2232	2160	2232	0	0	13,2
	PK	0.0	0.0	0.0	0.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0	3
ı			BASE	UTILITY										
	HOTLD	170	153	170	164	0	0	0	0	0	0	164	170	9
	PK	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0
2			BASE	UTILITY										
	CHILLD	0	0	0	0	290	281	290	290	281	290	0	0	1,7
	PK	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0
5			BASE	UTILITY										
	HOTLD	25	22	25	24	0	0	0	Ö	0	0	24	25	1
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
ı			AREA	100 EXI	ST AIR	COOLED RE	CIP CHI	LLR						
	ELEC	0	0	0	0	12971	17212	21161	21472	14265	5314	0	0	92,3
	PK	0.0	0.0	0.0	0.0	47.5	53.0	56.9	56.3	47.8	35.0	0.0	0.0	56
1	EQ5001			LED WATE	R PUMP	CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,8
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2
	EQ5300			ROL PANE										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,4
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1
ı	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,8
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2

'HIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

	•••••			E Q	UIP	MENT	ENE	RGY	CONS	UMPT	1 0 N	•••••	•••••	
Ref	Equip					Mon	thiv con	el motion						
	Code	Jan	Feb	Mar	Арг	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2			AREA	100 EXI	ST AIR	COOLED R	FCID CUI	110						
	ELEC	0	0	0	0	16071	21001	25828	26166	17429	6417	0	0	112.012
	PK	0.0	0.0	0.0	0.0	58.3	64.4	69.1	68.0	57.9	42.2	0.0	0.0	69.1
2	E95001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	MF						
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,892
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2.2
2	E95300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	4,416 1.0
2	EQ5001		CHIL	LED WATE	R PLIMP	- CONST	ANT VOLU	uc						
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	0.002
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	9,892
3			ARFA	100 EXI	ST AID	COOLED R	ECID CUI	116						
	ELEC	0	0	0	0	1988	1982	2111	2106	1941	4047	_	_	
	PK	0.0	0.0	0.0	0.0	28.4	29.7	30.8	30.6	28.6	1917 26.3	0.0	0.0	12,045 30.8
3	EQ5001		CHILI	LED WATE	R PILMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	833	806	833	833	806	833	0	0	1 244
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
3	EQ5300		CONTI	ROL PANEI	L & INT	FRIOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744		•	
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0 0.0	4,416 1.0
4			AREA	100 EXI	ST AIR (COOLED R	FCIP CHI	1 D						
	ELEC	0	0	0	0	11076	14142	17246	17487	12190	4633	0	0	74 777
	PK	0.0	0.0	0.0	0.0	37.5	42.4	44.8	44.4	38.6	27.0	0.0	0.0	76,773
4	EQ5001		CHILI	ED WATER	R PUMP	- CONST	ANT VOLU	WF.						
	ELEC	0	0	0	0	833	806	833	833	806	833	0	0	4.044
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	4,946
4	EQ5300		CONTR	OL PANEI	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	, ,,,
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	4,416 1.0
5			AREA	100 EXIS	ST AIR 1	COOLED RI	כום כשיי	I P						
	ELEC	0	0	0	0	15584	18461	21788	22374	16854	8963	0	0	10/ 02/
	PK	0.0	0.0	0.0	0.0	49.6	51.8	53.8	53.3	49.8	45.5	0.0	0.0	104,024 53.8

'JIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 .SE CASE

f	Equip -					Mon	thly Con	sumption						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Tota
5	E95001		CHIL	LED WATE	R PUMP	- CONST.	ANT VOLU	ME						
	ELEC	0	0	0	0	275	266	275	275	266	275	o	0	1,6
	PK	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0
	E95300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4.4
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1
			AREA	100 EXI	ST AIR (COOLED R	ECIP CHI	LLR						
	ELEC	0	0	0	0	16505	20599	24401	25104	18009	9158	0	0	113,7
	PK	0.0	0.0	0.0	0.0	61.4	66.6	71.5	72.2	62.9	49.7	0.0	0.0	72
	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						_
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,8
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2
	E95300		CONT	ROL PANE	L & INTI	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4.4
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1
			AREA	100 EXI	ST AIR (COOLED R	ECIP CHI	LLR						
	ELEC	0	0	0	0	16505	20599	24401	25104	18009	9158	0	0	113,7
	PK	0.0	0.0	0.0	0.0	61.4	66.6	71.5	72.2	62.9	49.7	0.0	0.0	72
	EQ5001			LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,8
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2
	E95300			ROL PANE	L & INTE	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,4
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1
	E91161			COOLED C			ONS							
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	E95200			ENSER FAI										
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	EQ5303		CONTR											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

TIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

ef	Equip					Mont	thly Cons	sumption						
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
9	EQ1161		AIR (COOLED CO			ONS							
	ELEC	0	0	0	0	9349	11812	14056	14784	10019	4806	0	0	64,825
	PK	0.0	0.0	0.0	0.0	63.6	66.4	68.8	68.3	63.8	58.9	0.0	0.0	68.8
9	E95200		CONDI	ENSER FAN	IS									
	ELEC	0	0	0	0	910	1147	1607	1421	987	452	0	0	6,524
	PK	0.0	0.0	0.0	0.0	4.5	4.8	6.2	6.2	4.6	3.6	0.0	0.0	6.2
9	EQ5303		CONTI	ROLS										
	ELEC	0	0	0	0	223	216	223	223	216	223	0	0	1,325
	PK	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.3
10			AREA	100 EXIS	T AIR (COOLED RE	ECIP CHII	LLR						•
	ELEC	0	0	0	0	15535	19517	23118	23816	17025	8376	0	0	107,387
	PK	0.0	0.0	0.0	0.0	59.0	64.1	68.9	69.7	60.6	47.5	0.0	0.0	69.7
10	EQ5001		CHIL	LED WATER	PUMP	- CONST	ANT VOLU	4E						
	ELEC	0	0	0	0	833	806	833	833	806	833	0	0	4,946
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
10	EQ5300		CONT	ROL PANEI	. & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
11			AREA	100 EXIS	ST AIR	COOLED R	ECIP CHI	LLR						
	ELEC	0	0	0	0	25325	31101	37574	37169	27737	11449	0	0	170,355
	PK	0.0	0.0	0.0	0.0	70.0	76.4	85.0	83.4	74.2	56.3	0.0	0.0	85.0
11	E95001		CHIL	LED WATER	R PUMP	- CONST.	ANT VOLU	ME						
	ELEC	0	0	0	0	2775	2686	2775	2775	2686	2775	0	0	16,472
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
11	EQ5300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
12			AREA	100 EXI	ST AIR	COOLED R	ECIP CHI	LLR						
	ELEC	0	0	0	0	16906	20372	24091	24748	17920	9344	0	0	113,383
	PK	0.0	0.0	0.0	0.0	60.4	65.5	70.3	70.6	61.9	49.6	0.0	0.0	70.6
12	EQ5001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						,
	ELEC	0	0	0	0	1109	1073	1109	1109	1073	1109	0	0	6,580
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	1.5

'HIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

•••				E Q	UIPF	ENT	ENER	G Y C	ONSU	MPTI	O N			
ef	Equip -					Mont	hly Cons	umption						
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
12	EQ5300		CONTI	ROL PANEL	. & INTE	RLOCKS								
-	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
13			ARFA	100 EXIS	ST AIR (COOLED RE	CIP CHIL	LR						
_	ELEC	0	0	0	0	4477	5511	6556	6721	4884	2466	0	0	30,616
	PK	0.0	0.0	0.0	0.0	16.1	17.3	17.9	17.8	16.6	12.9	0.0	0.0	17.9
3	EQ5001		CHIL	LED WATER	PUMP -	- CONSTA	NT VOLUM	F						
•	ELEC	0	0	0	0	833	806	833	833	806	833	0	0	4,946
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
17	E95300		CONT	ROL PANEI	2 1411	EDI OCKS								
•	ELEC	0	0	0	0	744	720	744	744	720	744	o	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
4				100 EXI										
	ELEC	0	0	0	0	6115	7877	9643	9951	6902	2830	0	0	43,319
	PK	0.0	0.0	0.0	0.0	21.6	23.9	26.2	26.6	22.6	16.0	0.0	0.0	26.6
4	EQ5001			LED WATE			NT VOLUE							
	ELEC	0	0	0	0	1109	1073	1109	1109	1073	1109	0	0	6,580
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	1.5
4	E95300		CONT	ROL PANE	L & INT	ERLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
5	EQ1161		AIR	COOLED C	OND COM	P < 15 TO	ONS							
	ELEC	0	0	0	0	1705	2262	2879	2931	1893	562	0	0	12,232
	PK	0.0	0.0	0.0	0.0	8.0	8.3	8.6	8.6	8.0	7.4	0.0	0.0	8.6
15	EQ5200		COND	ENSER FA	NS									r
	ELEC	0	0	0	0	140	184	243	238	157	45	0	8	1,008
	PK	0.0	0.0	0.0	0.0	0.6	0.7	0.7	0.7	0.6	0.4	0.0	0.0	0.7
15	EQ5303		CONT	ROLS										
	ELEC	0	0	0	0	223	216	223	223	216	223	O	0	1,325
	PK	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.3
16			AREA	100 EXI	ST AIR	COOLED R	ECIP CHI	LLR						,
	ELEC	0	0	0	0	55068	61582	70144	71148	58363	30555	0	0	346,860
	PK	0.0	0.0	0.0	0.0	117.2	122.9	133.5	137.3	118.3	87.7	0.0	0.0	137.3

'HIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

кет	Equip					HOTE	ary cons	diperon						
ium	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
16	EQ5001		CHILL	ED WATER	R PUMP -	CONSTA	NT VOLUM	E						
	ELEC	0	0	0	0	4166	4032	4166	4166	4032	4166	0	0	24,730
	PK	0.0	0.0	0.0	0.0	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0	5.6
16	EQ5300		CONTR	ROL PANE	L & INTE	RLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
17			AREA	100 EXI	ST AIR C	OOLED RE	CIP CHIL	LR						
	ELEC	0	0	0	0	3737	5121	6202	6182	3955	1429	0	0	26,626
	PK	0.0	0.0	0.0	0.0	13.8	15.3	16.5	16.7	14.0	9.8	0.0	0.0	16.
17	EQ5001		CHILI	ED WATE	R PUMP -	CONSTA	ANT VOLUM	Œ						
	ELEC	0	0	0	0	558	540	558	558	540	558	0	0	3,31
	PK	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8	8.0	0.0	0.0	0.
17	EQ5300		CONT	ROL PANE	L & INTE	RLOCKS								
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,41
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.
1			WATE	RTUBE BO	ILER							1		
	GAS	506	499	160	109	0	0	0	0	0	0	172	481	1,92
	PK	1.8	2.0	1.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.8	2.
1	E95020		HEAT	ING WATE	R CIRCUL	ATION P	JM P							
	ELEC	678	635	484	403	0	Ō	0	0	0	0	491	687	3,37
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.
1	E95311		BOIL	ER CONTR	ous									
	ELEC	76	71	54	45	0	0	0	0	0	0	55	77	37
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
1	EQ5020		HEAT	ING WATE	R CIRCUL	ATION P	JMP							
	ELEC	833	753	833	806	0	0	0	0	0	0	806	833	4,86
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.
2			WATE	RTUBE BO	ILER									
	GAS	600	578	184	127	0	0	0	0	0	0	203	571	2,26
	PK	2.1	2.3	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.1	2.
2	EQ5020		HEAT	ING WATE	R CIRCUL	ATION P	UMP							
	ELEC	833	753	833	806	0	0	0	0	0	0	806	833	4,86
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.

"HIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 .SE CASE

f	Equip					HOLLE	irty cons	diperon						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	0ct	Nov	Dec	Total
2	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	54
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
2	EQ5020		HEAT	ING WATE	R CIRCUL	ATION PU	MP							
	ELEC	833	753	833	806	0	0	0	0	0	0	806	833	4,865
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.
3			WATE	RTUBE BO	ILER									
	GAS	140	126	140	135	0	0	0	0	0	0	135	140	815
	PK	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2
3	E95020		HEAT	ING WATE	R CIRCUL	ATION PU	MP							
	ELEC	275	249	275	266	0	0	0	0	0	0	266	275	1,607
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.0
3	E95311		BOIL	ER CONTR	OLS									
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
4			WATE	RTUBE BO	ILER									
	GAS	480	454	137	100	0	0	0	0	0	0	152	447	1,769
	PK	1.5	1.5	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.5	1.5
4	E95020		HEAT	ING WATE	R CIRCUL	ATION PL	IM P							
	ELEC	275	249	275	266	0	0	0	0	0	0	266	275	1,60
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
4	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	93	84	93	90	0	0	O	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
4	EQ5240		BOIL	ER FORCE	D DRAFT	FAN								_
	ELEC	2775	2507	2775	2686	0	0	0	0	0	0	2686	2775	16,20
	PK	3.7	3.7	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	3.
5			WATE	RTUBE BO	ILER									
	GAS	188	172	78	66	0	0	0	0	0	0	79	175	75
	PK	1.3	1.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.
5	EQ5020		HEAT	ING WATE	R CIRCUL	ATION PL	JMP							
	ELEC	212	194	148	133	0	0	0	0	0	0	144	208	1,03
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.

'JIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

..SE CASE

ef	Equip				• • • • • • • • • • • • • • • • • • • •	Mont	nty cons	umption -						
LITA	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
5	E95311		BOIL	ER CONTR	OLS									
	ELEC	72	66	50	45	0	0	0	0	0	0	48	70	35
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
6			WATE	RTUBE BO	ILER									
	GAS	276	273	119	101	0	0	0	0	0	0	112	245	1,12
	PK	1.7	1.8	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	1.
6	EQ5020		HEAT	ING WATE	R CIRCULA	ATION PU	MP							
-	ELEC	360	338	297	270	0	0	0	0	0	0	290	349	1,90
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.
6	E95311		BOIL	ER CONTR	OLS									
-	ELEC	60	56	49	45	0	0	0	0	0	0	48	58	31
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
7			UATE	RTUBE BO	IIFR									
•	GAS	276	273	119	101	0	0	0	0	0	0	112	245	1,12
	PK	1.7	1.8	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	1.12
7	E95020		HEAT	ING WATE	R CIRCUL	ATION PU	MP							
•	ELEC	360	338	297	270	0		0	0	0	0	290	349	1,90
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.
7	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	60	56	49	45	0	o	0	0	0	0	48	58	31
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
8	EQ2454		REST	DENTIAL	GAS FURN	ACE WITH	FAN							
_	GAS	85	83	37	26	0	0	0	0	0	0	36	78	34
	PK	0.5	0.5	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.
8	EQ5254		RESI	DENTIAL	FURNACE	FAN								
_	ELEC	5758	5157	4670	4080	0	0	0	0	0	0	4624	5713	30,00
	PK	11.3	11.3	11.3	11.3	0.0	0.0	0.0	0.0	0.0	0.0	11.3	11.3	11.
9			WATE	RTUBE BO	ILER									
	GAS	276	273	119	101	0	0	0	0	0	0	112	245	1,12
	PK	1.7	1.8	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	1.
9	E95020		HEAT	ING WATE	R CIRCUL	ATION PL	MP							
	ELEC	360	338	297	270	0	0	0	0	0	0	290	349	1,90
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.

'HIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 .SE CASE

ef	Equip					HOTE	hly Cons	callpt for						
JM)	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
9	EQ5311		BOILE	ER CONTRO	OLS									
	ELEC	60	56	49	45	0	0	0	0	0	0	48	58	317
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
0			WATER	RTUBE BOI	ILER									***************************************
	GAS	294	306	103	100	0	D	0	0	0	0	100	258	1,161
	PK	1.5	1.6	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5	1.6
0	E95020		HEAT	ING WATER	R CIRCUL	ATION PU	MP							
	ELEC	466	415	279	270	0	0	0	0	0	0	270	436	2,136
	PK	0.8	8.0	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	8.0	0.8
0	EQ5311		BOIL	ER CONTRO	OLS									
	ELEC	78	69	47	45	0	0	0	0	0	0	45	73	358
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
1			WATE	RTUBE BO	ILER									,
	GAS	294	306	103	100	0	0	0	0	0	0	100	258	1,16
	PK	1.5	1.6	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5	1.6
1	EQ5020		HEAT	ING WATE	R CIRCUL	ATION PL	IMP							
	ELEC	466	415	279	270	0	0	0	0	0	0	270	436	2,130
	PK	8.0	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	8.0	0.8
1	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	78	69	47	45	0	0	0	0	0	0	45	73	356
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
12			WATE	RTUBE BO	ILER									-
	GAS	219	207	94	90	0	0	0	0	0	0	91	190	892
	PK	1.5	1.5	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.5	1.5
12	EQ5020		HEAT	ING WATE	R CIRCUL	ATION PL	JMP							
	ELEC	240	235	186	180	0	0	0	0	0	0	180	235	1,25
	PK	0.8	8.0	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.1
2	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	40	39	31	30	0	0	0	0	0	0	30	39	21
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
3			WATE	RTUBE BO	ILER									
	GAS	93	89	37	30	0	0	0	0	0	0	38	88	37
	PK	0.5	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.0

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1 SE CASE

f	Equip ·					HOIT	hly Cons	disperon						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
13	EQ5020		HEAT	ING WATER	CIRCULA	ATION PU	MP							P
	ELEC	225	209	157	134	0	0	0	0	0	0	161	219	1,106
	PK	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6
3	E95311		BOILE	R CONTRO	DLS					•				
	ELEC	50	47	35	30	0	0	0	0	0	0	36	49	247
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
			WATER	RTUBE BO	LER									
	GAS	261	252	82	55	0	0	0	0	0	0	91	252	99
	PK	1.0	1.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0	1.
4	EQ5020		HEAT	ING WATER	R CIRCUL	ATION PU	MP							-
	ELEC	833	753	833	806	0	0	0	0	0	0	806	833	4,86
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.
•	EQ5311		BOIL	ER CONTRO	DLS									
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	54
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
;	EQ2454		RESI	DENTIAL	GAS FURN	ACE WITH	FAN							
	GAS	97	91	29	18	0	0	0	0	0	0	31	92	35
	PK	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.
5	EQ5254		RESI	DENTIAL	FURNACE	FAN								
	ELEC	540	488	540	523	0	0	0	0	0	0	523	540	3,15
	PK	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.
5			GAS	FIRED ST	EAM BOIL	ER								
	GAS	350	344	233	226	0	0	0	0	0	0	226	339	1,71
	PK	2.2	2.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.1	2.
5	E95311			ER CONTR										
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	54
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.
,			GAS	FIRED ST	EAM BOIL	ER								
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
7	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	0	0	0	0	0	O	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.

HIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

	•••••	•••••	• • • • • • • • • • • • • • • • • • • •	E Q	UIPM	ENT	ENER	G Y C	ONSU	MPTI	O N	•••••	• • • • • • • • • • • • • • • • • • • •	••••••
Ref	Equip					Mont	hly Cons	umption	•••••			•••••		
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
18			WATE	RTUBE BO	ILER									
	GAS	149	150	53	33	0	0	0	0	0	0	61	137	583
	PK	0.6	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.6
18	E95020		HEAT	ING WATE	R CIRCUL	ATION PU	HP							<u></u> 1
	ELEC	188	182	152	133	0	0	0	0	0	0	162	191	1,008
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
18	EQ5311		BOIL	ER CONTR	OLS									
	ELEC	63	61	52	45	0	0	0	0	0	0	55	65	341
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 AIR COOLED SINGLE SCREW CHILLERS

f	Equip					Hon	ithly con	sumption						
m	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	0ct	Nov	Dec	Total
0	LIGHTS													
	ELEC	99030	89550	105452	94800	102241	101222	95819	105452	94800	102241	94800	95819	1,181,2
	PK	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444
1	MISC LD		•											
	ELEC	O	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	ō	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK .	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
5	MISC LD													
	P CHILL	0	0	0	O	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
ı				E UTILIT										
	CHILLD	0	0	0	0	13786	13342	13786	13786	13342	13786	0	0	81,8
	PK	0.0	0.0	0.0	0.0	18.5	18.5	18.5	18.5	18.5	18.5	0.0	0.0	18
١	EQ1510	_		COOLED										
	ELEC	0	0	0	0	78520			105495	86547	42216	0	0	508,
	PK	0.0	0.0	0.0	0.0	210.8	234.2	240.0	240.0	221.0	187.4	0.0	0.0	240
ı	E95200	_		DENSER F										
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
1	EQ5001			ILLED WAT			ANT VOLU							
	ELEC	0	0	0	0	16651	16114	16651	16651	16114	16651	0	0	98,
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	2

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2 AIR COOLED SINGLE SCREW CHILLERS

	*******		•••••	E Q	UIPI	HENT	ENE	RGY	CONS	JMPT	I O N			
Ref	Equip					Mon:	thly Cons	sumption					•	
Num	Code	Jan	Feb	Mar	Apr	Hay	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	E95302		CONT	ROLS										
	ELEC	0	0	0	0	74	72	74	74	72	74	0	0	442
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1
2	EQ1510		AIR	COOLED S	ERIES R	(RTAA)								-
	ELEC	0	0	0	0	27164	41842	56709	61232	28981	4824	0	0	220,753
	PK	0.0	0.0	0.0	0.0	210.8	234.2	240.0	240.0	221.0	147.2	0.0	0.0	240.0
2	E95001		CHIL	LED WATE	R PUMP	- CONST	ANT VOLU	ME						
	ELEC	0	0	0	0	4431	6624	8236	8818	4476	985	0	0	33,570
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
2	E95302		CONT	ROLS										
	ELEC	0	0	0	0	20	30	37	39	20	4	0	0	150
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
NATURAL DRAFT WATER TUBE BOILERS

tef	Equip					Mor	ithly Cons	sumption						
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
٥	LIGHTS													
	ELEC	99030	89550	105452	94800	102241	101222	95819	105452	94800	102241	94800	95819	1,181,224
	PK	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	(
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
5	MISC LD													
	P HOTH20	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
1				E UTILIT										
	HOTLD	371	335	371	359	0	0	0	0	0	0	359	371	2,16
	PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.
2		***		E UTILIT				_			_			
	HOTLD	825	745	825	798	0	-	0	0	0	0	798	825	4,81
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.
1		177		TERTUBE B								071	1007	17.55
	GAS	1753 7.5	1911	775	479	0		0		0		834	1807	7,55
	PK	7.5	7.5	7.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0	6.2	7.5	7.
1	EQ5020		HE	ATING WAT	ER CIRC	ULATION	PUMP							
	ELEC	5028	4461	5550	5371	0	0	0	0	0		5371	5021	30,80
	PK	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
NATURAL DRAFT WATER TUBE BOILERS

ef	Equip		• • • • • • • • • • • • • • • • • • • •			Mont	hlv Cons	umption						
um	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5311		ROTI	ER CONTR	01.6									10141
•	ELEC	84												
			75	93	90	0	0	0	0	0	0	90	84	516
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
2			WATE	RTUBE BO	ILER									
	GAS	1824	1665	0	0	0	0	0			_	_		
	PK	16.7	16.7	0.0	0.0				0	0	0	0	1420	4,909
		1017	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	16.7
2	EQ5020		HEAT	ING WATE	R CIRCUL	ATION PU	MP							
	ELEC	1522	1623	0	0	0	0	0	0			_		
	PK	11,2	11.2	0.0	0.0	0.0				0	0	0	1309	4,454
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2
2	EQ5311		BOIL	ER CONTRE	OLS									
	ELEC	17	18	0	0	O	0	0	0	•		_		
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	15	50

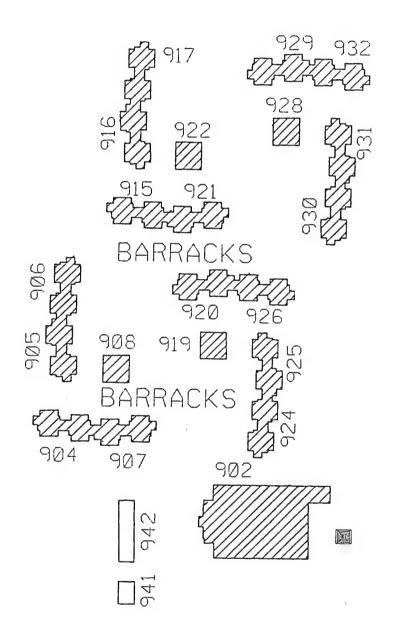
APPENDIX C

DATA FORMS

APPENDIX C DATA FORMS

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BUILDING DESCRIPTION

NAME: Buildings 904, 905, 906, 907, 915, 916, 917, 920, 921, 924, 925, 926, 929, 930, 931, 932 USE: Barracks for single enlisted personnel and attendees of the NCO Academy. Approximately 1 to 3 people per room, and 24 rooms per building. Buildings occupied continuously through the year.

GROSS AREA (SQ.FT.): 11,220 STORIES: 3 DATE OF SURVEY: 11/30 to 12/2/95

DATE OF CONSTRUCTION: 1974

STRUCTURE: Masonry.

EXTERIOR WALLS: Brick

ROOF: Flat built-up roof.

FLOOR CONSTRUCTION: Slab on grade.

FLOOR FINISH: Concrete and Carpet.

<u>CEILINGS</u>: Lay-in acoustical tile in hallways and plaster ceilings in personnel rooms.

WINDOWS: single pane, clear glass.

COOLING EQUIP: Two-pipe, horizontal fan coil units in each room and hallway and vertical fan coil units in lounge areas. Units are mostly located above restroom ceilings. There are approximately 23 room units, 6 lounge units and 6 corridor units per building. Units are served by central chiller in building 902.

HEATING EQUIP: See cooling equipment above. Units served by central boiler in building 902.

<u>LIGHTING</u>: Wall mounted incandescent fixtures in quarters and lounges, with lay-in fluorescent fixtures in hallways.

<u>DOMESTIC WATER HEATING:</u> Heat exchanger and 588 gallon storage tank in basement of each building, served by central boilers in building 902.

OTHER: Combination chilled water/heating water pump in each building.

<u>REMARKS</u>: Poor temperature control, extremely hot during field survey. All mechanical systems appeared to be in a deteriorated state, particularly the HVAC controls and piping distribution system. Leaks and rampant condensation were common throughout all buildings. Corrosion built-up on fan coil units due to placement above restroom ceilings. Also causes accessibility problems for maintenance personnel.

BUILDING DESCRIPTION

NAME: Buildings 908, 919, 922, 928

<u>USE:</u> Buildings 919 & 928 are used for recreation, post office, etc. Average occupancy is 5 persons, between 5 pm till midnight, Monday through Friday, and 9 am till midnight on weekends. Buildings 908 & 922 are used for battalion administration offices, with an average occupancy of 5 persons daily.

GROSS AREA (SQ.FT.): 2,050 STORIES: 1 DATE OF SURVEY: 11/30 to 12/2/95

DATE OF CONSTRUCTION: 1974

STRUCTURE: Masonry.

EXTERIOR WALLS: Brick.

ROOF: Flat built-up roof.

FLOOR CONSTRUCTION: Slab on grade.

FLOOR FINISH: Carpet.

CEILINGS: Lay-in acoustical tile.

WINDOWS: Single pane with tempered glass.

<u>COOLING EQUIP</u>: Each building has a four-pipe, central air handling unit for both heating and cooling. Air handlers typically have a 3 HP fan motor. Units are served by central chiller in building 902.

<u>HEATING EQUIP</u>: See cooling equipment above. Units are served by central boiler in building 902.

<u>LIGHTING</u>: Lay-in fluorescent fixtures in open areas, restrooms and offices and recess incandescent lights in hallways.

DOMESTIC WATER HEATING: Electric water heater in each building, 15 gallon, 1250 W each.

OTHER: Combination chilled water/heating water pump in each building, typically 1-1/2 HP each. REMARKS: Poor temperature control, extremely hot during field survey, doors were opened to control temperatures. All mechanical systems appeared to be in a deteriorated state, particularly the HVAC controls and piping insulation.

BUILDING DESCRIPTION

NAME: Building 902

<u>USE:</u> Used as administrative offices and classrooms, 7 am until 5 pm, Monday through Friday.

Maximum 180 persons when occupied. Other portions used as central boiler and chiller plant for other buildings in the 900 area.

GROSS AREA (SQ.FT.): 23,723 STORIES: 1 DATE OF SURVEY: 11/30 to 12/2/95

DATE OF CONSTRUCTION: 1974

STRUCTURE: Masonry.

EXTERIOR WALLS: Brick.

ROOF: Flat built-up roof.

FLOOR CONSTRUCTION: Slab on grade.

FLOOR FINISH: Carpet

CEILINGS: Lay-in acoustical tile

WINDOWS: Single pane with clear glass.

<u>COOLING EQUIP</u>: Two four-pipe central air handlers with individual return air fans are serving the administrative and classroom areas. Units are served by central chiller in building 902.

<u>HEATING EQUIP</u>: See cooling equipment above. Units are served by central boiler in building 902.

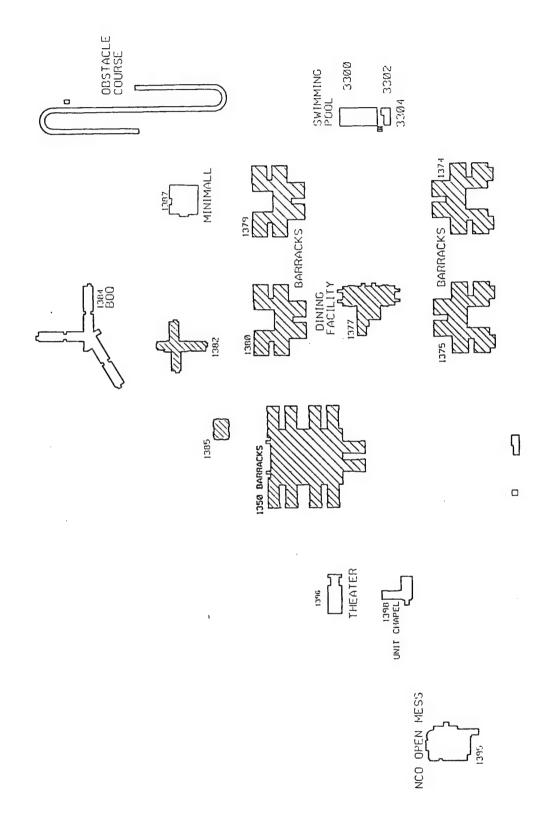
<u>LIGHTING</u>: Lay-in fluorescent fixtures in the admin and classrooms, industrial fluorescent fixtures in the storage area, and recess

<u>DOMESTIC WATER HEATING:</u> Heating water to domestic hot water heat exchanger in central plant, served by central boilers in building 902.

OTHER: Central chiller and boiler equipment, see HVAC Equipment List for descriptions.

<u>REMARKS</u>: Poor temperature control, extremely hot during field survey. All mechanical systems appeared to be in a deteriorated state, particularly the HVAC controls and piping insulation. Exhaust fans appeared to operate while central AHUs were off. Return air grilles appeared to be excessively dirty. Room remodeling has restricted the return air pattern back to the air handling units.

		HVAC EQUIP	HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 900 JUNE 2, 1995	RT SAM HOUST	ON, AREA 900				
T and the I	Ì		מויימים אותיא	YEAR	FULL	g	ER. TIN	ES	ANNUAL USE
LEM		DESCRIPTION	AKEA SEKVED	INSTALLED	LOAD	HRS	HRS DAYS WK	WKS	KWH MCF
Water Chiller	-	York #YTC303C1CJC water cooled, centrifugal, 304 tons, R-11	Area 900	1985	225 KW	24	7	26	444,056
Chilled Water Pump	-	Weinman 720 gpm, 100 ft 25 HP	Area 900	1985	18.65 KW	24	7	26	82,358
Condenser Water Pump	-	Weinman 912 gpm, 50 ft 15 HP	Area 900	1985	11.19 KW	24	7	26	49,415
Cooling Tower	-	Marley #MC8608 one cell 15 HP fan	Area 900	1979	11.19 KW	24	7	26	45,510
Hot Water Boiler	က	Ajax #WG 2250 natural draft, watertube 1665 MBH output	Area 900	1979	2,250 MBH	24	7	26	7,809
Heating Water Pump	٢	Weinman 200 gpm, 38 ft 5 HP	Area 900	1979	3.73 KW	24	7	26	32,675
Heating Water Pump	+	Weinman 115 gpm, 30 ft 5 HP	Area 900	1979	3.73 KW	24	7	26	32,675
Heating Water Pump	-	Weinman 115 gpm, 30 ft 2 HP	Area 900	1979	1.49 KW	24	7	26	13,052
Heating Water Pump	-	Peerless 1.5 HP	Bldg. 902	1979	1.12 KW	24	7	26	9,811



NAME: Building 1350

<u>USE:</u> Barracks, administrative offices, dining and classrooms for single enlisted personnel.

Maximum occupancy of 800 persons with current occupancy of 1550 personnel.

GROSS AREA (SQ.FT.): 261,406 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1983

STRUCTURE: Masonry

EXTERIOR WALLS: Both brick and precast panel.

ROOF: Flat built-up roof.

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: Concrete topping, tile, and carpet

<u>CEILINGS</u>: Lay in acoustical tile, plaster, and stucco

WINDOWS: Single pane with glazed, insulating glass.

<u>COOLING EQUIP</u>: Total of seven central multi-zone, variable volume air handling units serving large areas of the building. Approximately 20 two-pipe fan coil units serving cadre rooms. All units are served by central chillers in building 1377.

<u>HEATING EQUIP</u>: See cooling equipment above. Multiple heating/ventilating units serving scrub rooms, toilets and kitchen areas along with heating water convection units serving multiple areas throughout building. All units are served by central boilers in building 1377.

<u>LIGHTING</u>: Lay-in fluorescent fixtures in barracks, admin, classrooms, and dining areas. Surface mounted fluorescent fixtures in kitchen and scattered incandescent fixtures.

<u>DOMESTIC WATER HEATING:</u> Gas fired hot water heaters in building to serve restrooms.

OTHER: 7 ½, ½, ½ HP heating water pumps in building. Steam boilers in building serve kitchen equipment.

<u>REMARKS:</u> Poor temperature control, extremely hot during field survey. Piping leaks are a problem. All other HVAC systems appeared to be in fair condition.

NAME: Buildings 1374, 1375, 1379, 1380

<u>USE</u>: Barracks for single enlisted personnel, classrooms and administrative offices. Maximum occupancy of approximately 475 people.

GROSS AREA (SQ.FT.): 111,448 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1971

STRUCTURE: Partially exposed structural steel frame

EXTERIOR WALLS: Brick and stucco veneer

ROOF: built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: concrete topping and carpet

<u>CEILINGS</u>: Lay-in acoustical tile in building with stucco over exposed areas

WINDOWS: single pane clear and tempered glass

<u>COOLING EQUIP</u>: Approximately six multi-zone, constant volume central air handlers serving barracks and office areas of the buildings. Approximately four cabinet type fan coil units serving classrooms in the buildings. All units served by central chillers in building 1377.

<u>HEATING EQUIP:</u> See cooling equipment above. All units served by central boilers in building 1377.

<u>LIGHTING</u>: Surface mounted incandescent fixtures in exposed areas. Lay-in fluorescent fixtures in admin and barracks areas.

<u>DOMESTIC WATER HEATING:</u> Gas fired hot water boilers in building to serve restrooms.

OTHER: Secondary 7 ½ and 5 HP chilled/heating water pumps in building.

<u>REMARKS</u>: Poor temperature control, extremely hot during field survey. Renovations to building has caused restricted return air flow back to air handling units. All other HVAC systems appeared to be in fair condition.

NAME: Building 1382

<u>USE</u>: Barracks for single enlisted personnel, administrative offices. Continuous occupancy of approximately 240 persons.

GROSS AREA (SQ.FT.): 29,390 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1971

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Flat Built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Gypsum wallboard and acoustical tile

WINDOWS: Single pane clear glass

<u>COOLING EQUIP</u>: Building served by two central multi-zone air handlers. Air handler cooling coils served by central chillers in building 1377.

<u>HEATING EQUIP:</u> See cooling equipment above. Air handler heating coils served by central boilers in building 1377.

LIGHTING: Surface and suspended mounted fluorescent fixtures

<u>DOMESTIC WATER HEATING:</u> Gas fired hot water heaters in building to serve restrooms.

OTHER: Secondary 3/4 HP chilled water and ½ HP heating water pumps in building.

<u>REMARKS</u>: Poor temperature control, extremely hot during field survey. All other HVAC systems appeared to be in fair condition. Outside air intake louvers have been blanked off with sheet metal, reducing HVAC loads but also reducing indoor air quality. Building may not meet ASHRAE standards for ventilation.

NAME: Building 1385

<u>USE:</u> Administrative services for 232nd Medical Battalion troops. Continuous occupancy of approximately 22 persons.

GROSS AREA (SQ.FT.): 5,072 STORIES: 1 DATE OF SURVEY: 11/30 to 12/2/94

DATE OF CONSTRUCTION: 1971

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Flat built-up roof

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile and gypsum wallboard

WINDOWS: Single pane clear glass

<u>COOLING EQUIP</u>: Building served by central multi-zone air handler in mechanical room. Air handler cooling coil served by central chiller in building 1377.

<u>HEATING EQUIP:</u> See cooling equipment above. Air handler heating coil served by central boiler in building 1377.

<u>LIGHTING</u>: Recessed and surface mounted fluorescent fixtures in office areas and surface mounted incandescent fixtures in other areas

<u>DOMESTIC WATER HEATING:</u> Electric, 66 gallon, 4500 W hot water heater in building to serve restrooms.

OTHER: Secondary 1/4 HP chilled water and 1/8 HP heating water pumps in building.

<u>REMARKS</u>: Poor temperature control, extremely hot during field survey. All other HVAC systems appeared to be in fair condition. Outside air intake louvers have been blanked off with sheet metal, reducing HVAC loads but also reducing indoor air quality. Building may not meet ASHRAE standards for ventilation.

NAME: Building 1377

<u>USE</u>: Kitchen and dining hall in building. Other areas serve as central chiller and boiler plant for buildings in 1300 area. Maximum occupancy of 800 persons on weekdays between 4 am and 9 pm.

GROSS AREA (SQ.FT.): 30,350 STORIES: 1

DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1971

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Sloped built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile, gypsum wallboard, and plaster

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: Dining areas served by two, single zone, central air handlers in mechanical room. Air handler cooling coils served by central chiller in building 1377. Kitchen served by two evaporative coolers only.

<u>HEATING EQUIP</u>: See cooling equipment above. Air handler heating coil served by central boiler in building 1377. Evaporative coolers serving kitchen have steam htg coil which is supplied by steam boiler in building 1377.

LIGHTING: Surface mounted fluorescent fixtures

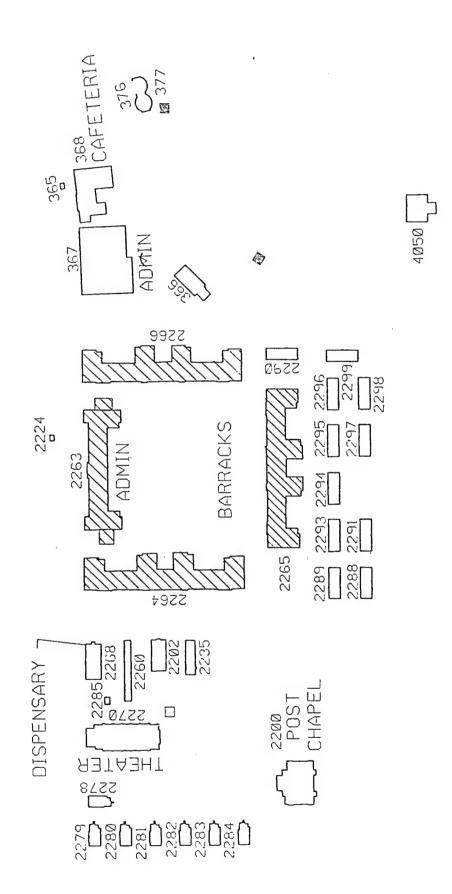
<u>DOMESTIC WATER HEATING:</u> Electric hot water heater in building to serve restrooms.

OTHER: Central chiller and boiler equipment, see HVAC Equipment List for descriptions along with steam boiler to serve bldg. 1377 kitchen equipment..

<u>REMARKS</u>: Poor temperature control, extremely hot during field survey. All mechanical systems appeared to be in a deteriorated state, particularly the HVAC controls and piping insulation. Exhaust fans appeared to operate while central AHUs were off. Return air grilles appeared to be excessively dirty.

	ANNUAL	YS WKS KWH MCF	26 1,464,005	26 130,286	26 595,685	26 164,716	26 131,830	26 171,908	26 98,830	26 210,896	26 60,215	26 32,406 15,611	3,140	. 26 0
	OPER. TIMES	S DAYS	4 7	4 7	4 7	7	4 7	4 7	7	7	7	7	7	7
		HRS	24	24	24	24	24	24	24	24	24	1 24	1 24	1 24
ON, AREA 130	FULL	LOAD	564 KW	564 KW	329 KW	18.65 KW	29.84 KW	29.84 KW	22.38 KW	52.22 KW	14.92 KW	8,369 MBH 7.46 KW	7,500 MBH	5,800 MBH
T SAM HOUST	YEAR	INSTALLED	1972	1972	1983	1972	1983	1972	1983	1972	1983	1972	1983	1983
HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 1300 JUNE 2, 1995		AREA SERVED	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	Bldg. 1350	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	Bldg. 1350	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	Bldg. 1350	Bidgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	Bldg. 1350	Bidgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	Bldg. 1350	Bldg. 1350
HVAC EQUIP		DESCRIPTION	Trane #PCV-5F-C1D1 water cooled, centrifugal, 600 tons, R-11	Trane #PCV-5F-C1D1 water cooled, centrifugal, 600 tons, R-11	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	Aurora 870 gpm, 79 ft 25 HP	Allis Chalmers 775 gpm, 114 ft 40 HP	Aurora 1440 gpm, 70 ft 40 HP	Allis Chalmers 1314 gpm, 30 ft 30 HP	Marley #324T induced draft, 2-35 HP fans	Marley induced draft, 20 HP fan	C.B. #CB700X-200 10 HP forced draft, 5912 MBH output	Rite #A750WG natural draft, watertube 5317 MBH output	Ajax #WGB 9500 natural draft, watertube 4336 MBH output
		ΩTY.	-	-	-	2	-	7	-	-	-	2	-	-
		MEL	Water Chiller	Water Chiller	Water Chiller	Chilled Water Pump	Chilled Water Pump	Condenser Water Pump	Condenser Water Pump	Cooling Tower	Cooling Tower	Hot Water Boiler	Hot Water Boiler	Hot Water Boiler

I NINA	KWH MCF	97,218	129,625					
U	WKS	26	56					
ODED TIMES	DAYS	7	7					i
	HRS	24	24					
ON, AREA 1300	LOAD	11.19 KW	29.84 KW					
T SAM HOUST	INSTALLED	1972	1983					
HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 1300	AREA SERVED	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	Bldg. 1350					
HVAC EQUIPA	DESCRIPTION	Aurora 443 gpm, 76 ft 15 HP						
	ΩTY.	2	-					
	ITEM	Heating Water Pump	Heating Water Pump					



NAME: Building 2263

<u>USE:</u> Administrative offices for post fiscal activities. Maximum occupancy of 250 persons from

6:30 am until 5:15 pm on weekdays.

GROSS AREA (SQ.FT.): 81,065 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1970

STRUCTURE: Masonry

EXTERIOR WALLS: Stucco on CMU

ROOF: Pitched shingle roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Lay-in acoustical tile

WINDOWS: single and double pane clear glass in most of building and insulating glass in corridors.

COOLING EQUIP: Eight, single zone central air handlers serving the general office areas.

Fourteen, four-pipe fan coil units serving corridors, stairwells and first floor office areas on the east and west ends. All units are served by the central chiller in building 2265.

<u>HEATING EQUIP</u>: See cooling equipment above. All units are served by the central boilers in building 2265.

LIGHTING: Recessed fluorescent fixtures and scattered incandescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: Packaged computer room units with outdoor fluid cooler serve the computer room in building. Some rooms in basement served by window units.

<u>REMARKS</u>: Poor temperature control. Extremely hot inside during field visit in mid March. Some inside areas were above 100 degrees F. All HVAC systems appeared to be in good condition with the exception of the temperature controls.

NAME: Buildings 2264, 2266

<u>USE</u>: Mainly barracks for single enlisted personnel, with administrative offices and classrooms.

Also houses the Academy Museum and band area. Maximum occupancy of 255 persons per building

on a continuous basis.

GROSS AREA (SQ.FT.): 98,190 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1970

STRUCTURE: Masonry

EXTERIOR WALLS: Plaster on stone

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Lay-in acoustical tile

WINDOWS: Single pane clear glass

COOLING EQUIP: Ten, four-pipe multi-zone air handlers serving all areas of the building.

Average 3 to 6 zones per unit. All units are served by the central chiller in building 2265.

HEATING EQUIP: See cooling equipment above. All units are served by the central boilers in

building 2265.

<u>LIGHTING</u>: Recessed fluorescent fixtures with incandescent fixtures scattered throughout building.

<u>DOMESTIC WATER HEATING:</u> Gas fired hot water heaters in building to serve restrooms.

REMARKS: Poor temperature control. Extremely hot inside during field visit in mid March. All

HVAC systems appeared to be in poor condition, especially the temperature controls.

NAME: Building 2265

<u>USE:</u> Mainly barracks for single enlisted personnel, with administrative offices and classrooms.

Also houses the mess hall and central boiler and chiller plants. Maximum occupancy of 600 persons at meal time, with approximately 200 persons on a continuous basis.

GROSS AREA (SQ.FT.): 105,564 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1970

STRUCTURE: Masonry

EXTERIOR WALLS: Plaster on stone wall

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile and gypsum wallboard

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: Ten, four-pipe multi-zone air handlers serving all areas of the building. Average 2 to 6 zones per unit. All units are served by the central chiller in building.

<u>HEATING EQUIP:</u> See cooling equipment above. All units are served by the central boilers in building behind.

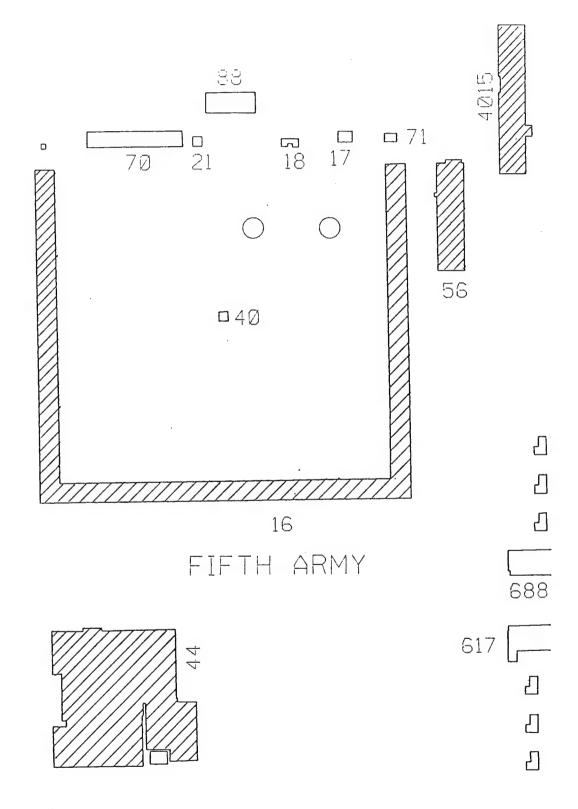
LIGHTING: Recessed fluorescent fixtures with incandescent scattered in building.

<u>DOMESTIC WATER HEATING:</u> Large gas fired boiler located in basement for domestic hot water heating in the building.

OTHER: Central chiller plant equipment in building and central boiler plant equipment in building behind. See HVAC Equipment Lists for descriptions. Steam boilers in basement serve kitchen equipment.

<u>REMARKS</u>: Poor temperature control. Extremely hot inside during field visit in mid March. All HVAC systems appeared to be in poor condition, especially the temperature controls. Boiler (heating water) plant appears in good condition, while chiller plant is aged.

	ANNUAL USE	KWH MCF	994,146	329,433	164,717	121,471	4,949	51,512	24			
	1		867	326	164	121		51	``			
	MES	WKS	26	56	56	56	26	56	56			
	OPER. TIMES	DAYS	7	7	7	7	7	7	7			
	Q	HRS	24	24	24	24	24	24	24			
ON, AREA 2200	FULL	LOAD	595 KW	74.60 KW	37.30 KW	29.84 KW	3,000 MBH	11.19 KW	0.56 KW			
F SAM HOUST	YEAR	INSTALLED	1973	1973	1973	1973	1988	1988	1988			
HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 2200 JUNE 2, 1995		AREA SERVED	Area 2200	Area 2200	Area 2200	Area 2200	Area 2200	Area 2200	Hot Water Boiler			
HVAC EQUIPN			Chrysler #C2MN779-2 water cooled, centrifugal, 657 tons, R-11	Paco 1526 gpm, 166 ft 100 HP	Paco 1971 gpm, 63 ft 50 HP	Built-up crossflow, 2 cell 2-20HP fans	Ajax #WGB 4750 natural draft, watertube 2240 MBH output	Armstrong 207 gpm, 110 ft 15 HP	Armstrong 3/4 HP			
	į	ΩT₹.	-	1	1	-	က	က	က			
		ITEM	Water Chiller	Chilled Water Pump	Condenser Water Pump	Cooling Tower	Hot Water Boiler	Heating Water Pump	Boiler Circulation Pump			



NAME: Building 4015

<u>USE:</u> Medical logistics training and offices, pharmaceutical storage. Maximum occupancy of 100 persons on weekdays, between 7:30 am and 4:30 pm.

GROSS AREA (SQ.FT.): 14,568 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1956

STRUCTURE: Frame

EXTERIOR WALLS: Stucco

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: wood covered with linoleum

CEILINGS: suspended metal lathe

WINDOWS: single pane clear glass

COOLING EQUIP: Three multizone air handlers serving the classrooms, offices and storage areas.

A 50 ton air cooled reciprocating chiller outside building serves the air handlers. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. A 800 MBH heating water boiler in building serving air handlers. See HVAC Equipment Lists for details.

LIGHTING: Suspended fluorescent fixtures

<u>DOMESTIC WATER HEATING:</u> Gas fired hot water heaters in building to serve restrooms.

OTHER: 5 HP chilled water pump and 2 HP heating water pump serving chiller and boiler. See HVAC Equipment Lists for details.

REMARKS: All HVAC equipment, including controls, appeared to be in fair condition.

NAME: Building 56

USE: Administrative offices for post security and pentathlon, classroom areas for training and

testing. Maximum occupancy of 65 persons during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 8,025 STORIES: 1 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1941

STRUCTURE: Frame

EXTERIOR WALLS: Siding and brick

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: One multi-zone air handler serving all conditioned areas of the building. Unit served by air cooled reciprocating chiller, approximately 30 tons nominal. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. Steam to heating water generator served from boiler in building 16, furnishing heating water for multizone above. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

<u>DOMESTIC WATER HEATING:</u> Gas fired hot water heaters in building to serve restrooms.

OTHER: 1 HP chilled water pump, and 1/8 HP heating water pump. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Poor temperature control, very hot inside during the field visit. All HVAC equipment appeared to be in fair to poor condition with the exception of new chiller, however most controls were not functioning properly.

NAME: Building 16

<u>USE:</u> Headquarters for the 5th Army. Maximum 300 occupants during weekdays between 6:30 am and 6:00 pm.

GROSS AREA (SQ.FT.): 76,102 STORIES: 2

DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Stone

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: concrete and carpet

CEILINGS: acoustical tile

WINDOWS: single and double pane clear glass and insulating glass in corridor

COOLING EQUIP: Approximately five, single zone air handlers serving office areas on the first and second floor. Four fan coil units serving the second floor corridor. All units served by two air cooled chillers outside building, total 230 nominal tons capacity. See HVAC Equipment Lists for details. Also 24 packaged DX cooling units serve the wing areas. DX units served by three evaporative condensers outside building. Computer room units served by air cooled condenser and stand alone compressor in building mechanical room.

<u>HEATING EQUIP</u>: See cooling equipment above. Steam unit heaters serve the wings. All units served by two steam boilers inside building, total 5,800 MBH total output capacity. See HVAC Equipment Lists for details.

<u>LIGHTING</u>: lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: Two, 7.5 HP chilled water pumps serving chillers. See HVAC Equipment Lists for details.

Condensate pumps scattered through building.

<u>REMARKS</u>: Poor temperature control, portions of building were comfortable while others were very hot during the field visit. All HVAC equipment appeared to be in fair to poor condition, however most controls were not functioning properly

NAME: Building 44

<u>USE</u>: Administrative offices for the 5th Army. Maximum occupancy of 350 persons during weekdays between 7:30 am and 4:30 pm.

GROSS AREA (SQ.FT.): 95,332 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/9

DATE OF CONSTRUCTION: 1956

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and Stucco

ROOF: Flat built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Lay-in acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: Two dual-duct air handlers serving 1st and 2nd floor offices. Single zone, VAV air handler serving 3rd floor offices. Five single zone air handlers serving 1st floor computer room, 1st floor addition and deli. Most units served by air cooled reciprocating chillers outside with total 255 nominal tons capacity. See HVAC Equipment Lists for details. 1st floor addition and deli unit are DX cooling.

<u>HEATING EQUIP</u>: See cooling equipment above. All units served by 13 steam boilers, total 3440 MBH output capacity. See HVAC Equipment Lists for details.

<u>LIGHTING:</u> Lay in fluorescent fixtures, recessed incandescent scattered in building.

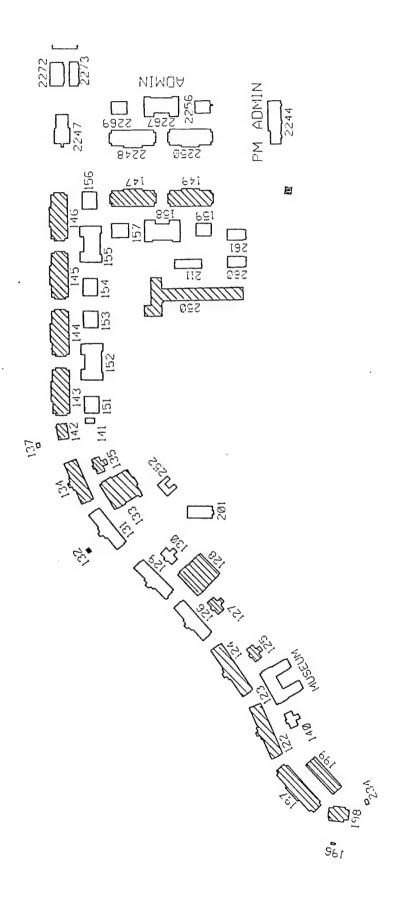
<u>DOMESTIC WATER HEATING:</u> Gas fired hot water heaters in building to serve restrooms.

OTHER: 20 HP chilled water pump serving chillers. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Poor temperature control in building. Extremely hot, especially on the second floor where the lights are on 24 hours/day. Large air handlers and boilers in this building are aging and in appear in poor condition.

		HVAC EQUIPMENT L	IST FOR:	A HOUSTON, C	FORT SAM HOUSTON, QUADRANGLE AREA	REA			
				YEAR	FULL	Q	OPER. TIMES	ES	ANNUAL USE
ITEM	oT.	DESCRIPTION	AREA SERVED	INSTALLED	LOAD	HRS	DAYS	WKS	KWH MCF
Water Chiller	-	TSI #CA2CD 75 air cooled, recip. 50 tons, R-22	Bldg. 4015	1983	88 KW	24	7	56	180,278
Chilled Water Pump	-	Paco 5 HP	Bldg. 4015	1983	3.73 KW	24	7	56	16,472
Hot Water Boiler	-	Rite #R8-C-05 forced draft, 5 HP blower 741 MBH output	Bldg. 4015	1987	1,000 MBH 3.73 KW	24	7	56	120
Heating Water Pump	-	N/A 3 HP	Bldg. 4015	1987	2.24 KW	24	7	56	1,821
Water Chiller	-	Trane #CDAGC30GACA air cooled, recip.	Bldg. 56	1993	49 KW	24	_	56	76,755
Chilled Water Pump	7	Amstrong 207 gpm, 110 ft 5 HP	Bldg. 56	1993	3.73 KW	24	7	56	32,944
Water Chiller	-	TSI #30AOCM 140 air cooled, recip. 120 tons	Bldg. 16	1994	194 KW	24	7	56	393,031
Water Chiller	-	TSI #CA2CM 110 air cooled, recip.	Bldg. 16	1987	190 KW	24	7	26	122,759
Chilled Water Pump	2	Taco 350 gpm, 50 ft 7.5 HP	Bldg. 16	1987	5.60 KW	24	7	26	49,460
Steam Boiler	-	Rite #2255 natural draft, watertube 1614 MBH output	Bldg. 16	1979	2,250 MBH	24	7	26	267
Steam Boiler	<u>-</u>	Rite #500 natural draft, watertube 3587 MBH output	Bldg. 16, Bldg 56	1979	5,000 MBH	24	7	26	651
Evaporative Condenser	-	Marley - 3 misc. models 2 - 3 HP & 5 HP pumps, 3 - 1/2 HP fans	Bldg. 16	1978	9.33 KW	24	_	26	41,201

		HVAC EQUIPMENT	HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, QUADRANGLE AREA	M HOUSTON, 0	DUADRANGLE	REA			
				YEAR	FULL	Q	OPER. TIMES	ES	ANNUAL USE
ITEM	Ω Ţ		AREA SERVED	INSTALLED	LOAD	HRS	DAYS WKS	WKS	KWH MCF
Water Chiller	-	York #LCHA 65 17D air cooled, recip. 65 tons	Bldg. 44	1985	114 KW	24	7	26	296,194
Water Chiller	2	York #LEHA 95 25D air cooled, recip. 95 tons	Bldg. 44	1985	167 KW	24	7	26	347,464
Chilled Water Pump	-	N/A 20 HP	Bldg. 44	1985	14.92 KW	24	7	26	65,887
Chilled Water Pump	7	Aurora 208 gpm, 421 ft 5 HP	Bldg. 44	1985	3.73 KW	24	7	26	10,858
Steam Boiler	7	HydroTherm modular 264 MBH output	Bldg. 44	1970	385 MBH	24	7	26	103
Steam Boiler	က	HydroTherm modular 236 MBH output	Bldg. 44	1970	335 MBH	24	7	26	99
	-								
	-								



NAME: Buildings 122 & 124

<u>USE:</u> Administrative offices - Dir. of Resource Management. Continuous occupancy of approximately 30 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 12,782 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and stone

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: Three multi-zone air handling units serving all conditioned areas of the building. Units served by air cooled reciprocating chiller, approximately 40 tons nominal in bldg. 122 & 50 tons nominal in bldg. 124.. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. Heating water is provided by 850 MBH heating water boiler in basement. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 3 HP chilled water pump, and 1-1/2 HP heating water pump. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Poor temperature control, very hot inside during the field visit. Building 124 was being renovated at the time of the site visit. All HVAC equipment appeared to be in fair to poor condition, however most controls were not functioning properly.

NAME: Buildings 125, 127, & 135

<u>USE:</u> Administrative offices - Community Operations Div., J. A. office, U.S.M.A. Admin. Field office. Continuous occupancy of approximately 5 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 1,593 STORIES: 1 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: Single pane clear glass

<u>COOLING EQUIP</u>: Building 125 is the only one of these buildings that has fan coils. The other two buildings have furnace units with evaporator coils. Bldgs. 125 and 135 are both served by air cooled chillers that also serve adjacent building 124 and 134. Building 127 is served by a 4.5 ton outdoor condensing unit. See HVAC Equipment Lists for details.

<u>HEATING EQUIP:</u> See cooling equipment above. Heating water for bldg. 125 and 135 is provided by a 820 MBH boiler in the basement of buildings 124 and 134. the furnace in Bldg. 127 is served by gas. See HVAC Equipment Lists for details.

<u>LIGHTING:</u> Lay-in fluorescent fixtures

<u>DOMESTIC WATER HEATING:</u> Electric hot water heater in building.

<u>REMARKS</u>: Poor temperature control, very hot inside during the field visit. All HVAC equipment appeared to be in fair to poor condition, however most controls were not functioning properly.

NAME: Building 128

USE: Boys & Girls Scouts Offices.

GROSS AREA (SQ.FT.): 14,224 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95 DATE

OF CONSTRUCTION: 1940

STRUCTURE: Frame

EXTERIOR WALLS: Brick, stone, and siding

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: Air handling units, fan coil units, and several window units serve all conditioned areas of the building. Units served by 40 ton nominal air cooled reciprocating chiller. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. Heating water is provided by 150 MBH heating water boiler in basement. See HVAC Equipment Lists for details.

<u>LIGHTING:</u> Lay-in fluorescent fixtures

<u>DOMESTIC WATER HEATING:</u> Electric hot water heater in building.

OTHER: 1-1/2 HP chilled water pump, and 1/2 HP heating water pump. See HVAC Equipment Lists for details.

<u>REMARKS</u>: This building was unavailable to be entered during site visit. Chiller appeared to be in fair condition.

NAME: Building 133

<u>USE</u>: Administrative offices - Medical/Pharmaceutical operations. Continuous occupancy of approximately 50 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 13,232 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and siding

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: Multi-zone air handling units and fan coil units serving all conditioned areas of the building. Units served by 25 ton nominal air cooled reciprocating chiller. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. Heating water is provided by 150 MBH heating water boiler in basement See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Electric hot water heater in building.

OTHER: 1-1/2 HP chilled water pump, and 1/2 HP heating water pump. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Temperature control in good condition. Comfortable inside during the field visit. All HVAC equipment appeared to be in fair condition.

NAME: Building 134

<u>USE:</u> Legal offices. Continuous occupancy of approximately 40 people during weekdays, between

7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 10,434 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and stone

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: Three multi-zone air handling units serving all conditioned areas of the building.

Units served by 30 ton nominal air cooled reciprocating chiller which also serves bldg. 135. See

HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water is provided by 820 MBH heating

water boiler in basement See HVAC Equipment Lists for details.

<u>LIGHTING</u>: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 1/2 HP chilled and heating water pumps. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control, very hot inside during the field visit especially on second

floor near window covered vestibule. All HVAC equipment appeared to be in fair to poor condition.

however most controls were not functioning properly.

NAME: Buildings 142

USE: Administrative offices - Reg. H.Q. and deferred maintenance.

GROSS AREA (SQ.FT.): 4,735 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1945

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and CMU

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: Single pane clear glass

COOLING EQUIP: This building is served by a 10 ton nominal air cooled chiller. See HVAC

Equipment Lists for details.

<u>HEATING EQUIP</u>: Heating water for this building is assumed to be provided by a 450 MBH boiler

in the basement. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Electric hot water heater in building.

REMARKS: This building was unavailable to be entered during site visit. Chiller appeared to be

in fair condition. This building has it's own electrical meter.

NAME: Buildings 143, 144, 145,146

<u>USE</u>: Administrative offices. Continuous occupancy of approximately 50 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 13,483 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry with frame add-on

EXTERIOR WALLS: Brick, stone and wood shingles

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass and tempered glass for enclosed porch

COOLING EQUIP: Bldgs. 143, 144, and 146 are served by multi-zone and single-zone air handling units, and bldg 143 contains packaged window units for cooling. The air handlers in bldg 143, 144, & 146 are served by 45, 45, & 40 ton nominal air cooled reciprocating chillers. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. The air handlers in bldgs. 143, 144, & 146 are served by an 850 MBH heating water boiler in the basements. Warm air furnace provides heating for bldg. 145. See HVAC Equipment Lists for details.

<u>LIGHTING</u>: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 3 HP chilled water pump, and 1 HP heating water pump in bldgs. 143 & 144. 1-1/2 HP chilled water pump and 1 HP heating water pump for bldg. 146. Building 144 also has a 4 ton condensing unit that serves computer room. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Building 143 was empty and awaiting renovation at the time of the site visit. Window units are in poor condition and thus create maintenance problems. All other HVAC equipment appeared to be in fair to poor condition and most controls were not functioning properly.

NAME: Buildings 147 & 149

<u>USE</u>: Billeting for Reserves, Family Residence. Continuous occupancy of approximately 50 people during weekdays, between 7:00 am and 5:00 pm.

<u>GROSS AREA (SQ.FT.):</u> 11,522 <u>STORIES:</u> 2 <u>DATE OF SURVEY:</u> 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1939

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: One multi-zone air handling unit serves each of these buildings. 50 ton air cooled reciprocating chiller serves both bldg. 147 & 149. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. Heating water is provided by 850 MBH heating water boiler in each bldgs. basement. See HVAC Equipment Lists for details.

<u>LIGHTING:</u> Lay-in fluorescent fixtures and scattered incandescent fixtures.

<u>DOMESTIC WATER HEATING:</u> Gas fired hot water heater in building.

OTHER: 5 HP chilled water pump, and two 1 HP heating water pumps. See HVAC Equipment Lists for details.

<u>REMARKS</u>: All HVAC equipment appeared to be in fair to poor condition. Piping between buildings appears to be deteriorating.

NAME: Buildings 197

<u>USE:</u> Headquarter of Fifth Army Band, future 323rd Medical Battalion Supply. Continuous occupancy of approximately 35 people during weekdays, between approximately 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 13,819 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Frame

EXTERIOR WALLS: Stucco

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile, Plaster

WINDOWS: Single pane clear glass

<u>COOLING EQUIP</u>: Three 4- Pipe, single-zone fan and coil units serve all conditioned areas of the building. Units served by air cooled reciprocating chiller, approximately 50 tons nominal. See HVAC Equipment Lists for details.

<u>HEATING EQUIP:</u> See cooling equipment above. Heating water is provided by 1750 MBH heating water boiler in basement. See HVAC Equipment Lists for details.

<u>LIGHTING</u>: Lay-in and surface mounted fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 2 HP chilled water pump, and 1 HP heating water pump. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Poor temperature control, very hot inside during the field visit. Very old ductwork with dust mold and mildew. Control problems create moisture pockets on furniture and causes moisture problems with computers. All HVAC equipment appeared to be in poor condition, and most controls were not functioning properly.

NAME: Building 198

<u>USE:</u> Physical/Medical Evaluation Board. Continuous occupancy of approximately 20 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 5,468 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1945

STRUCTURE: Frame

EXTERIOR WALLS: Stucco

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile, Plaster

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: Two single-zone fan and coil units serving all conditioned areas of the building. Units served by nominal 10 ton air cooled reciprocating chiller. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above and unit heater. Heating water is provided by 450 MBH heating water boiler in basement. See HVAC Equipment Lists for details.

LIGHTING: Surface mounted incandescent fixtures and fluorescent fixtures

DOMESTIC WATER HEATING: Electric water heater in building.

OTHER: 1-1/2 HP chilled water pump, and 3/4 HP heating water pump. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Poor temperature control. Air-side equipment is maintenance intensive. All HVAC equipment appeared to be in poor condition.

NAME: Building 199

<u>USE:</u> Band Rehearsal Hall. Intermittent occupancy of approximately 60 people during weekdays,

between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 6,415 STORIES: 1 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION 1940

EXTERIOR WALLS: Stucco

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Plaster

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: One multi-zone air handling unit serves all conditioned areas of the building. Unit is served by nominal 15 ton air cooled reciprocating chiller. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. Heating water is provided by 200 MBH heating water boiler in basement. See HVAC Equipment Lists for details.

LIGHTING: Recessed and surface mounted fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 2 HP chilled water pump, and 1-1/2 HP heating water pump. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Poor temperature control. Area is critical to humidity control because instruments are susceptible to humidity. All HVAC equipment appeared to be in fair condition, however most controls were not functioning properly.

NAME: Building 250

<u>USE:</u> NCO Academy, barracks, and future chef training school. Continuous occupancy of approximately 250 people between 5:00 pm and 7:00 a.m.

GROSS AREA (SQ.FT.): 42,955 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Stucco

ROOF: Flat built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete, tile and carpet

CEILINGS: Acoustical tile, gypsum wallboard, plaster

WINDOWS: single pane clear glass

<u>COOLING EQUIP</u>: Six multi-zone air handling units serve the barracks portion of building and one multi-zone air handling unit serves the future chef school. All units are served by a 100 ton nominal air cooled reciprocating chiller. See HVAC Equipment Lists for details.

<u>HEATING EQUIP</u>: See cooling equipment above. All heating coils in the air handlers are steam. Steam is provided by 1000 MBH steam boiler in basement. See HVAC Equipment Lists for details.

<u>LIGHTING</u>: Lay-in fluorescent fixtures in future chef school, admin, and barracks; surface mounted incandescent and fluorescent fixtures in barracks.

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 7-1/2 HP chilled water pump. See HVAC Equipment Lists for details.

<u>REMARKS</u>: Poor temperature control, very hot inside during the field visit. The air cooled chiller appeared to be in good condition and all other HVAC equipment appeared to be in fair condition.

		HVAC EQUIP	HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100	T SAM HOUST	ON, AREA 100					
			מונה ליו	YEAR	FULL	ဝီ	OPER. TIMES	ES	ANNUAL USE	'n
ITEM	ΩTY.	DESCRIPTION	AREA SERVED	INSTALLED	LOAD	HRS	DAYS	WKS	KWH N	MCF
Hot Water Boiler	-	Rite #HD-85 watertube 618 MBH output	Bldg. 122	1985	850 MBH	24	7	26		193
Heating Water Pump	7	B&G 32 gpm, 50 ft 1.5 HP	Bldg. 122	1985	1.12 KW	24	_	26	8,242	
Water Chiller	1	Trane #CGABC401AF01FK air cooled. recip.	Bldg. 122	1985	70 KW	24	7	56	92,395	
Chilled Water Pump	2	N/A 3 HP	Bldg. 122	1985	2.24 KW	24	7	26	19,784	
Hot Water Boiler	1	Ajax natural draft, watertube 618 MBH output	Bldgs. 124, 125	1985	850 MBH	24	7	56		226
Heating Water Pumps	2	Amtrol 23 GPM, 50 ft 1.5 HP	Bldgs. 124, 125	1985	1.12 KW	24	7	26	9,730	
Water Chiller	Ψ-	TSI #30-AOCD65 air cooled, recip. 50 tons	Bldgs. 124, 125	1985	88 KW	24	7	56	112,912	
Chilled Water Pumps	2	Mueller 53 gpm, 71 ft 3 HP	Bldgs. 124, 125	1985	2.24 KW	24	7	56	19,784	
Split System Fumace	-	RUUD 33 MBH output	Bldg 127	1985	45 MBH	24	7	26	3,154	36
Condensing Unit	-	RUUD #UACC-056JAS 4.5 ton, 7 EER	Bldg 127	1985	8.48 KW	24	7	26	13,240	
Hot Water Boiler	1	N/A 109 MBH output	Bldg. 128	1985	150 MBH	24	7	26		82
Heating Water Pump	~	N/A 1/2 HP	Bldg. 128	1985	0.37 KW	24	7	56	1,607	

		HVAC EQUIPME	MENT LIST FOR: FORT SAM HOUSTON, AREA 100 JUNE 2, 1995	T SAM HOUST	ON, AREA 100				
				YEAR	FULL	g	OPER. TIMES	ES	ANNUAL USE
EM	<u>م</u>	DESCRIPTION	AREA SERVED	INSTALLED	LOAD	HRS	DAYS	WKS	KWH MCF
Water Chiller	-	Trane #CGABC403AE00F air cooled, recip.	Bldg. 128	1985	70 KW	24	7	56	12,045
Chilled Water Pump	-	N/A 1.5 HP	Bldg. 128	1985	1.12 KW	24	7	56	4,946
Hot Water Boiler	-	Ajax #WGHD-150 forced draft, 5 HP blower 109 MBH output	Bldg. 133	1985	150 MBH 3.73 KW	24	7	26	16,203
Heating Water Pump	-	N/A 1/2 HP	Bldg. 133	1985	0.37 KW	24	7	56	1,607
Water Chiller	-	Trane #CGABC256AF01FK air cooled, recip. 25 tons	Bldg. 133	1985	44 KW	24	7	56	76,773
Chilled Water Pump	Ψ-	Aurora 40 gpm, 70 ft 1.5 HP	Bldg. 133	1985	1.12 KW	24	7	56	4,946
Hot Water Boiler	-	Thermopak #GWE 825 watertube 596 MBH output	Bidgs 134, 135	1985	820 MBH	24	7	56	116
Heating Water Pump	-	Armstrong, close coupled	Bidgs 134, 135	1985	0.37 KW	24	7	56	2,136
Water Chiller	-	Trane #CGACC306KANDD air cooled, recip. 30 tons	Bldgs 134, 135	1985	53 KW	24	7	56	104,024
Chilled Water Pump	-	Armstrong, close coupled 63 ft, 1/2 HP	Bidgs 134, 135	1985	0.37 KW	24	7	56	1,634
Hot Water Boiler	1	N/A 327 MBH output	Bldg. 142	1985	450 MBH	24	7	56	28
Heating Water Pump	-	N/A 1/2 HP	Bldg. 142	1985	0.37 KW	24	7	56	1,008

		HVAC EQUIP	HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100	T SAM HOUST	ron, AREA 100				
			מונה לי	YEAR	FULL	g	OPER. TIMES	ES	ANNUAL USE
ITEM	ΩT≺.	DESCRIPTION	AREA SERVED	INSTALLED	LOAD	HRS	DAYS	WKS	KWH MCF
Water Chiller	-	Carrier #30GT-020-500 air cooler, recip. 10 tons	Bldg. 142	1985	18 KW	24	7	26	26,626
Chilled Water Pump	-	N/A 1 HP	Bldg. 142	1985	0.75 KW	24	7	26	3,312
Water Chiller	-	N/A air cooled, recip. 45 tons	Bidg. 143	1985	79 KW	24	7	26	113,775
Chilled Water Pump	-	N/A 3 HP	Bldg. 143	1985	2.24 KW	24	7	26	9,892
Hot Water Boiler	-	N/A 596 MBH output	Bldg. 143	1985	820 MBH	24	7	26	76
Heating Water Pump	-	N/A 1/2 HP	Bldg. 143	1985	0.37 KW	24	7	56	1,039
Water Chiller	-	TSI #CAZCD 45 air cooled, recip. 45 tons	Bldg. 144	1985	79 KW	24	7	26	113,775
Chilled Water Pump	-	Aurora 58 gpm, 86 ft 3 HP	Bldg. 144	1985	2.24 KW	24	7	26	9,892
Hot Water Boiler	-	Bryan 596 MBH output	Bldg. 144	1985	820 MBH	24	7	26	112
Heating Water Pump	-	B&G 1 HP	Bldg. 144	1985	0.75 KW	24	7	26	1,904
Terminal Cooling Unit	-	Data Temp #DTA-0532-01 Russell #TD6.5 condenser 4 ton, 9 EER	Bldg. 144	1985	5.81 KW	24	7	26	0
Window A/C Units	23	Fredrich #MDD YL 24H3513 2 ton clg, 22.4 MBH htg. 9 EER	Bldg. 145	1985	2.67 KW	24	7	52	71,349

		HVAC EQUIP	HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100 JUNE 2, 1995	RT SAM HOUST	ON, AREA 100				
	3		ADEA 050\/60	YEAR	FULL	ОР	OPER. TIMES	IES	UAL
N I	2.		AKEA SERVED	INSTALLED	LOAD	HRS	DAYS	WKS	KWH MCF
Hot Water Boiler	4-	Teledyne Laars 596 MBH	Bldg. 146	1985	820 MBH	24	7	52	112
Heating Water Pump	-	N/A 1 HP	Bldg. 146	1985	0.75 KW	24	7	25	1,904
Water Chiller	-	Trane #CGABC404AF00F air cooled, recip. 40 tons	Bldg. 146	1985	70 KW	24	7	52	107,387
Chilled Water Pump	-	Taco 83 gpm, 1.5 HP	Bldg. 146	1985	1.12 KW	24	7	52	4,946
Hot Water Boiler	1	Ajax #WG-750-5 596 MBH output	Bldg. 147	1985	820 MBH	24	7	52	112
Heating Water Pump	-	Taco 1 HP	Bldg. 147	1985	0.75 KW	24	7	52	1,904
Water Chiller	-	McQuay #ALR 040AD air cooled, recip. 50 tons	Bldgs 147, 149	1985	88 KW	24	7	26	170,355
Chilled Water Pump	-	Paco 5 HP	Bldgs 147, 149	1985	3.73 KW	24	7	26	16,472
Hot Water Boiler	-	Thermopak #GWE 825 596 MBH output	Bldg. 149	1985	820 MBH	24	7	56	116
Heating Water Pump	-	Paco 40 gpm, 40 ft 1 HP	Bldg. 149	1985	0.75 KW	24	7	26	2,136
Hot Water Boiler	- -	Ajax #WG-1750 1400 MBH output	Bldg. 197	1985	1,750 MBH	24	7	26	88
Heating Water Pump	-	B&G 1 HP	Bldg. 197	1985	0.75 KW	24	7	56	1,257

		HVAC EQUIP	HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100	RT SAM HOUST	ON, AREA 100	Č	i	C	
ITEM	ΩT.	DESCRIPTION	AREA SERVED	YEAR	FULL	HRS HRS	OPER. TIMES IS DAYS W	ES WKS	ANNUAL USE KWH MCF
Water Chiller	-	York #LCHA 50-17A air cooled, recip. 50 tons	Bldg. 197	1985	88 KW	24	7	26	113,383
Chilled Water Pump	-	Peerless 2 HP	Bldg. 197	1985	1.49 KW	24	7	26	6,580
Hot Water Boiler	-	National #209-7 natural draft 327 MBH output	Bldg. 198	1985	450 MBH	24	7	26	38
Heating Water Pump	-	Тасо 3/4 НР	Bldg. 198	1985	0.56 KW	24	7	26	1,106
Water Chiller	-	Trane #MAUG-C156-B air cooled. recip. 10 tons	Bldg. 198	1985	18 KW	24	7	26	30,616
Chilled Water Pump	-	N/A 1.5 HP	Bldg. 198	1985	1.12 KW	24	7	26	4,946
Hot Water Boiler	-	Ajax #WG-200-S natural draft 145 MBH output	Bldg. 199	1985	200 MBH	24	7	26	66
Heating Water Pump	+	N/A 1.5 HP	Bldg. 199	1985	1.12 KW	24	7	56	4,865
Water Chiller	-	RUUD #RAWC 150 CAS air cooled. recip. 15 tons	Bldg. 199	1985	26 KW	24	7	26	43,319
Chilled Water Pump	-	N/A 2 HP	Bldg. 199	1985	1.49 KW	24	7	26	6,580
Steam Boiler	7	Kewanee #581, series 3X 800 MBH output	Bldg. 250	1985	1,000 MBH	24	7	56	172
				1985					

	ANNUAL USE KWH MCF	346,860	24,730						
			26 2						
	OPER. TIMES HRS DAYS WKS	7	7						
	OPE HRS	24	24						
ON, AREA 100	FULL	160 KW	5.60 KW						
T SAM HOUST	YEAR	1985	1985				-		
HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100 JUNE 2, 1985	AREA SERVED	Bldg. 250	Bldg. 250		•				
HVAC EQUIPN	DESCRIPTION	Trane #CGACD111 air cooled, recip. 100 tons							
	ΩTY.	-	-						
	ITEM	Water Chiller	Chilled Water Pump			•			

APPENDIX D RECOMMENDED ECO CALCULATIONS

APPENDIX D RECOMMENDED ECO CALCULATIONS

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ECO-A, Replace Existing Central Chiller With New Electric Screw Chiller, Area 900	D-1
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ECO-I, Replace Existing Individual Building Chillers With Central Chiller Plant, Area 100	D-62

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:

Α

DATE:

6/15/95

ECO TITLE:

Replace Existing Central Chiller With New Electric Screw Chiller

INSTALLATION:

Fort Sam Houston, San Antonio, Texas

LOCATION:

Area 900, Building 902

A. Summary:

Electrical Energy Savings	434	MMBTU/yr
Electrical Demand Savings	2,520	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	434	MMBTU/yr
Total Cost Savings	17,650	\$/yr
Total Investment	157,256	\$
Simple Payback	8.9	yrs
SIR	2.08	

B. ECO Description:

Remove the existing 300 ton, R-11 centrifugal chiller in building 902 and replace it with a 300 ton, R-134a screw chiller. The existing 25 HP chilled water (CHW) pump, 15 HP condenser water (CND) pump and 15 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

C. Discussion:

The existing water cooled, centrifugal chiller was installed in 1985 and serves as the primary cooling system for the 21 buildings in the 900 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996¹. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates². However, since the machine is already ten years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a dual screw chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 300 tons is required to adequately cool the buildings³. Therefore, no increase or decrease in the current chiller capacity is recommended at this time.

D. Savings Calculations:

1. Energy Consumption And Savings

The monthly peak demand and energy consumptions of the existing and proposed alternative chillers and auxiliary equipment were calculated using the Trace 600 computer program⁴. The buildings served by the existing chiller were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models⁵.

The 300 ton chiller alternatives which were compared included an electric centrifugal machine, an electric centrifugal with a variable frequency drive, a dual screw machine and a gas driven centrifugal machine. All proposed machines used R-134a. Full and part load performance data from York International were used in the computer simulations of the new chiller energy usages⁶. Equipment lists of the specific chillers and auxiliaries for each alternative modeled by the computer are shown on pages D-4 to D-7.

Once the computer simulations were completed, the total annual demand cost and energy consumption of each alternative were compared with that of the existing systems to determine the annual savings for each⁷. These savings calculations are shown on pages D-8 and D-9. The demand and energy savings values were used in the life cycle cost analysis for each alternative. The results of these savings calculations were as follows:

Alternative	Chiller Type	Demand Savings \$/yr	Electrical Savings MMBTU/yr	Gas Savings MMBTU/yr
A1	Electric Centrifugal	2,870	253	0
A2	Electric Centrifugal & VFD	3,167	529	0
A3	Electric Screw	2,520	434	0
A4	Gas Driven Centrifugal	10,987	1,516	-3,386

2. Maintenance Cost Savings:

By installing a new chiller in place of the existing one, the installation will save the cost of retrofitting the machine for the HCFC-123 refrigerant as mentioned previously. The cost of this retrofit was estimated to be \$248,085 on page D-10. This value was used in the life cycle cost analysis as a non-recurring savings for each alternative.

E. Cost Estimates

The total installation costs for each alternative chiller mentioned in this ECO were estimated on pages D-11 through D-14. These costs were used in the life cycle cost analysis for each alternative. The results of the costs estimates were as follows:

Alternative	Chiller Type	Estimated Cost
A1	Electric Centrifugal	\$153,242
A2	Electric Centrifugal & VFD	\$193,215
A3	Electric Screw	\$157,256
A4	Gas Driven Centrifugal	\$349,928

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on each chiller alternative for this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for each life cycle cost analysis is shown on pages D-15 through D-18. The results of the alternative life cycle cost analysis were as follows:

Alternative	Chiller Type	Payback Years	SIR
A1	Electric Centrifugal	9.1	2.05
A2	Electric Centrifugal & VFD	10.2	1.97
A3	Electric Screw	8.9	2.08
A4	Gas Driven Centrifugal	14.6	1.11

Since the electric screw chiller has the highest SIR, it is recommended as the most economical choice to replace the existing machine. The data from the life cycle cost analysis for this alternative were included in the summary on page D-1.

REFERENCES

- 1. Per current EPA regulations on CFC refrigerants.
- 2. See Appendix G for chiller retrofit estimates from Northeastern Research And Engineering Corporation.
- 3. See Appendix B for Area 900 cooling system load profile.
- 4. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 5. See Appendix C for building field data and existing HVAC system data.
- 6. See Appendix G for manufacturer's equipment performance data from York International.
- 7. See Appendix A for utility cost analysis data, used in the savings calculations.

	_						 	 	 	
	JAL (KWH MCF	370,072	82,358	49,415	45,441				•
	ES	WKS	56	56	56	56				
00	OPER. TIMES	DAYS	7	7	7	7				
AREA 9	ОР	HRS	24	24	24	24				
AM HOUSTON,	FULL	LOAD	177 KW	18.65 KW	11.19 KW	11.19 KW				
0-A1, FORT S	YEAR	INSTALLED	New	Exist	Exist	Exist				
MENT LIST FOR: EC		AREA SERVED	Area 900	Area 900	Area 900	Area 900				
PROPOSED HVAC EQUIPMENT LIST FOR: EC0-A1, FORT SAM HOUSTON, AREA 900 JUNE 2, 1995		DESCRIPTION	York, electric water cooled, centrifugal, 300 Tons, R-134a			#MC8608 I an				
		o F	-	-	-	-				
*		ITEM	Water Chiller	Chilled Water Pump	Condenser Water Pump	Cooling Tower				

P. R.		PROPOSED HVAC EQUI	PROPOSED HVAC EQUIPMENT LIST FOR: ECO-A2, FORT SAM HOUSTON, AREA 900 JUNE 2, 1995	O-A2, FORTS	SAM HOUSTON,	AREA	006			
ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR	FULL	P S S	OPER. TIMES	ES	ANNUAL USE KWH MCF	USE
Water Chiller	-	York, electric, VFD water cooled, centrifugal, 300 Tons, R-134a,	Area 900	New	177 KW	24	7	26	289,309	
Chilled Water Pump	-	Weinman 720 gpm, 100 ft 25 HP	Area 900	Exist	18.65 KW	24	7	26	82,358	
Condenser Water Pump	-	Weinman 912 gpm, 50 ft 15 HP	Area 900	Exist	11.19 KW	24	7	26	49,415	
Cooling Tower	-	Marley #MC8608 one cell 15 HP fan	Area 900	Exist	11.19 KW	24	7	26	45,401	

رند دغ.		PROPOSED HVAC EQUIPMENT LIST FOR: ECO-A3, FORT SAM HOUSTON, AREA 900 JUNE 2, 1995	PMENT LIST FOR: EC JUNE 2, 19	O-A3, FORT S	SAM HOUSTON,	AREA	006		
TEM	7		AREA SERVED	YEAR	FULL	ဝ	≧	ES	AF.
I EIM	3		טורט סבווע	INSTALLED	LOAD	HRS	HRS DAYS	WKS	KWH MCF
Water Chiller	1	York, electric water cooled, dual screw 300 Tons, R-134a	Area 900	New	186 KW	24	7	26	317,039
Chilled Water Pump	-	Weinman 720 gpm, 100 ft 25 HP	Area 900	Exist	18.65 KW	24	7	26	82,358
Condenser Water Pump	-	Weinman 912 gpm, 50 ft 15 HP	Area 900	Exist	11.19 KW	24	7	26	49,415
Cooling Tower	~	Marley #MC8608 one cell 15 HP fan	Area 900	Exist	11.19 KW	24	7	26	45,444

	ANNUAL USE	KWH MCF	3,386	82,358	49,415	45,352				
	ES	WKS	26	26	56	56				
00	OPER. TIMES	HRS DAYS	7	7	7	7				
AREA 9	OP	HRS	24	24	24	24				
SAM HOUSTON,	FULL	LOAD	1,980 MBH	18.65 KW	11.19 KW	11.19 KW				
.0-A4, FORT S	YEAR	INSTALLED	New	Exist	Exist	Exist				
PMENT LIST FOR: EC	ADEA CEDVED	AREA SERVED	Area 900	Area 900	Area 900	Area 900				
PROPOSED HVAC EQUIPMENT LIST FOR: EC0-A4, FORT SAM HOUSTON, AREA 900 JUNE 2, 1995			York, gas fired water cooled, centrifugal 300 Tons, R-134a	Weinman 720 gpm, 100 ft 25 HP	Weinman 912 gpm, 50 ft 15 HP	Marley #MC8608 one cell 15 HP fan				
	5	2	1	-	-	-				
***************************************	11011	I EM	Water Chiller	Chilled Water Pump	Condenser Water Pump	Cooling Tower				

ITEM					ING C			LER PI	LANT				ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					202.4	202.7	223.5	225.8	208.0	115.8			444,056	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,510	
Totals					243.4	243.7	264.5	266.8	249.0	156.8			621,339	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					1,826	2,437	2,645	2,668	2,490	1,176				

Total Demand

13,242 \$/yr

Total Energy

2,121 MMBTU/yr

(electric)

Total Energy

MMBTU/yr

(gas)

ITEM			ECO-	A1: NE	W ELE MONTH				AL CHI	LLER			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					155.7	143.0	168.4	175.9	147.1	80.7			370,072	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,441	
Total (KW)					196.7	184.0	209.4	216.9	188.1	121.7			547,286	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					1,475	1,840	2,094	2,169	1,881	913				

Total Demand

10,372 \$/yr

Demand Savings

2,870 \$/yr

Energy Savings

253 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

(gas)

ITEM		ECO	-A2: N	EW EL	ECTRI MONTH	C CEN			ILLER	WITH	VFD		ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					144.1	138.0	166.7	175.3	141.8	69.5			289,309	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,401	
Total (KW)					185.1	179.0	207.7	216.3	182.8	110.5			466,483	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					1,388	1,790	2,077	2,163	1,828	829				

Total Demand

10,075 \$/yr

Demand Savings

3,167 \$/yr

(electric)

Energy Savings Energy Savings

529 MMBTU/yr MMBTU/yr

ITEM			E	CO-A3:	NEW I				CHILLE	R			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					163.7	150.3	176.9	184.9	154.6	76.2			317,039	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,444	
Total (KW)					204.7	191.3	217.9	225.9	195.6	117.2			494,256	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					1,535	1,913	2,179	2,259	1,956	879				

Total Demand

10,721 \$/yr

Demand Savings

2,520 \$/yr

Energy Savings

434 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

(gas)

ITEM		!	ECO-A	4: NEV	V GAS MONTH				GAL CI	HILLER			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller														3,386
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,352	
Total (KW)					41.0	41.0	41.0	41.0	41.0	41.0			177,125	3,386
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00			7.50		5,555
Cost (\$)					308	410	410	410	410	308				

Total Demand

2,255 \$/yr

Demand Savings

10,987 \$/yr

Energy Savings

1,516 MMBTU/yr

(electric)

Energy Savings

-3,386 MMBTU/yr

							,	
ENGINEER'S ESTIN	AATE	OF	PRO	ESTIMATE OF PROBABLE COST	soo =	⊢		
LOCATION:		PROJECT NO:	T NO:)	03-0185.04		DATE:	6/16/95
AREA 900, BUILDING 904, FOR BAIM HOUSION		BY:	PIEPER, C.A.	.A.		НЭ	снескер ву:	CAP
PROJECT DESCRIPTION: ECO-A - Upgrade Existing R-11 Chiller To Operate With R-123	er To Ope	erate W	ith R-12	ស្ល				
	QUANTITY	TITY		LABOR		MATERIAL	RIAL	10707
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Retrofit of existing R-11 chiller to use R-123	-	20	80.00	\$28.00	\$2,240	\$175,000	\$175,000	\$177,240
R-123 detection system	-	20				\$5,000	\$5,000	\$5,000
Chiller 2-speed ventilation fan	-	20	16.00	\$25,00	\$400	\$1,185	\$1,185	\$1,585
(1.11)	Ŝ	400	004	408.00	\$1120	427	\$270	\$1390
Chiller ventilation louver	2	2 2	3	00.00	071.14	170	0/72	000
Test & balance	-	20	4.00	\$50.00	\$200			\$200
					000		A404 A60	4100 410
	!	ľ		SUBIOIAL	\$2,300		\$101,400	CI+,COI+
HUITT-ZOLLARS, INC.			K 07 (2) L 8		76/4		167,000	600,100
ENGINEERS / ARCHITECTS				SUBTOTAL	\$4,752		\$217,746	\$222,498
512 MAIN STREET. SUITE 1500			DESIGN @ 6%	%9				\$13,350
FORT WORTH, TEXAS 76102-3922				SUBTOTAL				\$235,848
(817) 335-3000 * FAX (817) 335-1025		S	SIOH @ 6.6%	%				\$12,237
				TOTAL				\$248,085

ENGINEER'S ESTIM	ATE	E OF	PRO	JBAB	ESTIMATE OF PROBABLE COST	ST		
LOCATION:		PROJECT NO:	ST NO:		03-0185.04		DATE:	6/16/95
AREA 900, PUIDING 902, FONT DAIN FIOUDION		BY:	PIEPER, C.A.	C.A.		당	снескер ву:	KLK
PROJECT DESCRIPTION: ECO-A1, Replace Existing Central Chiller With New Centrifugal Chiller	Chiller	With Ne	iw Centi	rifugal Chil	ler			
	QUA	QUANTITY		LABOR		MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove chiller	-	EA	5	\$24.64	\$986	\$500	\$500	\$1,486
Install New Chiller 300 ton, water cooled, centrifugal, R-134a	-	EA	933	\$24.64	\$22,989	\$78,000	\$78,000	\$100,989
Pipe Assembly And Valves	-	EA	42	\$24.64	\$1,035	\$3,300	\$3,300	\$4,335
RECONNECT:								
Controls	-	JOB	45	\$24.64	\$1,109	\$100	\$100	\$1,209
Electrical	-	JOB	22	\$24.64	\$542	\$200	\$200	\$742
Refrigerant Detection System And Ventilation	-	JOB	4	\$24.64	\$1,010	\$4,000	\$4,000	\$5,010
Test & Balance and Start-up	1	JOB	20	\$28.00	\$560	\$200	\$200	\$760
				SUBTOTAL	\$28,231		\$86,300	\$114,531

HUITT-ZOLLARS, INC, ENGINEERS / ARCHITECTS 512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922 (817) 335-3000 * FAX (817) 335-1025

\$7,559

\$153,242

TOTAL

SUBTOTAL

SIOH @ 5.5%

\$8,246 \$145,683

\$137,437

\$17,260

\$22,906

\$5,646 \$33,877

O&P@20%

SUBTOTAL

DESIGN @ 6%

ENGINEER'S ESTI	MAT	E OF	PR(JBAB	ESTIMATE OF PROBABLE COST	ST		
LOCATION:		PROJE	PROJECT NO:		03-0185.04		DATE:	6/16/95
AKEA SUU, DUIDING SUZ, FUKI SAM HUUSIUN		BY:	PIEPER, C.A.	C.A.		нэ	снескер ву:	KLK
PROJECT DESCRIPTION: ECO-A2, Replace Existing Central Chiller With New Centrifugal Chiller And Variable	al Chille	r With N	ew Cent	crifugal Ch	iller And Va	ariable Freque	Frequency Drive (VFD)	(a:
	QUA	QUANTITY		LABOR	2	MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs/ Unit	Rate	Total	Unit Price	Total	COST
Remove chiller	-	EA	4	\$24.64	\$986	\$500	\$500	\$1,486
		i	100	0,04	00000	000 004	000	000000
Install New Chiller 300 ton, water cooled, centrifugal, K-134a		EA	222	\$24.64	696,224	000'0/\$	000'0/4	600,001¢
Adder For VFD	-	S.J				\$29,875	\$29,875	\$29,875
Pipe Assembly And Valves	-	EA	42	\$24.64	\$1,035	\$3,300	\$3,300	\$4,335
RECONNECT:								
Controls	-	JOB	54	\$24.64	\$1,109	\$100	\$100	\$1,209
Electrical	-	JOB	22	\$24.64	\$542	\$200	\$200	\$742
Refrigerant Detection System And Ventilation	-	306	41	\$24.64	\$1,010	\$4,000	\$4,000	\$5,010
Test & Balance and Start-up	-	JOB	20	\$28.00	\$560	\$200	\$200	\$760
				SUBTOTAL	\$28,231		\$116,175	\$144,406
HIITT-701 LARS INC.			O&P@20%	%0	\$5,646		\$23,235	\$28,881
				SUBTOTAL	\$33.877		\$139.410	\$173.287

512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922 (817) 335-3000 * FAX (817) 335-1025

ENGINEERS / ARCHITECTS

\$10,397 \$183,684 \$9,531 \$193,215

TOTAL

SUBTOTAL

SIOH @ 5.6%

DESIGN @ 6%

\$173,287

\$139,410

\$33,877

SUBTOTAL

ENGINEER'S ESTIN	ATE	: OF	PR(JBAB	ESTIMATE OF PROBABLE COST	ST		
LOCATION:		PROJECT NO:	CT NO:		03-0185.04		DATE:	6/16/95
AREA 300, BUILDING 304, FORI SAM HOUSION		BY:	PIEPER, C.A.	C.A.		CH	снескер ву:	KLK
PROJECT DESCRIPTION: ECO-A3, Replace Existing Central Chiller With New Water Cooled Dual Screw Chiller	l Chiller	- With N	ew Wat	er Cooled	Dual Screw	, Chiller		
	QUA	QUANTITY		LABOR	3	MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove chiller	-	EA	4	\$24.64	\$386	\$500	\$500	\$1,486
Install New Chiller 300 ton, water cooled, dual screw, R-134a	-	EA	933	\$24.64	\$22,989	\$81,000	\$81,000	\$103,989
			!		100	000	000	1 2 4
Pipe Assembly And Valves	-	EA	45	\$24.64	GSO,1*	000,04	000,00	\$4,000
WECONNECT:								
Controls	-	JOB	45	\$24.64	\$1,109	\$100	\$100	\$1,209
Electrical	-	JOB	22	\$24.64	\$542	\$200	\$200	\$742
Refrigerant Detection System And Ventilation	-	JOB	4	\$24.64	\$1,010	\$4,000	\$4,000	\$5,010
Test & Balance and Start-up	-	JOB	20	\$28.00	\$560	\$200	\$200	\$760

HUITT-ZOLLARS, INC. ENGINEERS / ARCHITECTS 512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922 (817) 335-3000 * FAX (817) 335-1025

\$8,462

\$149,499

\$7,757 \$157,250

TOTAL

SUBTOTAL

SIOH @ 6.5%

DESIGN @ 6%

\$23,506

\$89,300

\$28,231

O&P@20%

SUBTOTAL

\$33,877

SUBTOTAL

\$117,531

\$141,037

\$107,160

ENGINEER'S ESTIMATE	ATE	OF	PR	PROBABLE	LE COST	ST		
LOCATION:		PROJECT NO:	CT NO:		03-0185.04		DATE:	6/16/95
AREA 900, BUILDING 904, LONI 90M HOUSTON		BY:	PIEPER, C.A.	C.A.		당	снескер ву:	KLK
PROJECT DESCRIPTION: ECO-A4, Replace Existing Central Chiller With New Gas Engine Driven Chiller	Chiller	With N	ew Gas	Engine Dr	iven Chiller			
	QUAN	QUANTITY		LABOR		MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove chiller	-	EA	4	\$24.64	\$986	\$500	\$500	\$1,486
		Ĺ	220	70 704	000000	000	4226 000	\$247 QAQ
netali New Chiller OCO ton, water coolea centrilugal, N-10-ta	-	5	3	10:13	477,000	4250,000	*****	000,1124
Pipe Assembly And Valves	-	EA	42	\$24.64	\$1,035	\$3,300	\$3,300	\$4,335
RECONNECT:								
Controls	1	JOB	45	\$24.64	\$1,109	\$100	\$100	\$1,209
Electrical	-	JOB	22	\$24.64	\$542	\$200	\$200	\$742
Refrigerant Detection System And Ventilation	-	JOB	4	\$24.64	\$1,010	\$4,000	\$4,000	\$5,010
Test & Balance and Start-up	-	300	20	\$28.00	\$560	\$200	\$200	\$760
				SUBTOTAL	\$28,231		\$233,300	\$261,531
HIIITT-701 I ARS INC.		0	& P @	70%	\$5,646		\$46,660	\$52,306
ENCINEEDS / APCHITECTS				SUBTOTAL	\$33,877		\$279,960	\$313,837
512 MAIN STREET, SUITE 1500		Q	DESIGN @ 6%	%9				\$18,830
FORT WORTH, TEXAS 76102-3922				SUBTOTAL				\$332,667
(817) 335-3000 * FAX (817) 335-1025		S	SIOH @ 6.6%	5%				\$17,261
				TOTAL				\$349,928

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A1 ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 137437. B. SIOH 7559. C. DESIGN COST 8246. D. TOTAL COST (1A+1B+1C) \$ 153242. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE G. TOTAL INVESTMENT (1D - 1E - 1F) 153242. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL S DISCOUNT DISCOUNTED MBTU/YR(2) FUEL \$/MBTU(1) SAVINGS(3) FACTOR (4) SAVINGS (5) A. ELECT S 6.28 253. 1589. 15.08 23960. B. DIST \$.00 0. 0. 18.57 0. C. RESID \$.00 0. 0. 21.02 0. D. NAT G S 2.66 0. 0. 18.58 0. \$ E. COAL \$.00 0. 0. 16.83 0. F. PPG 0. .00 0. 17.38 0. M. DEMAND SAVINGS 2870. 14.88 42706. 253. \$ N. TOTAL 4459. 66665. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED ITEM COST(-) OC FACTR SAVINGS(+)/ (3) (1) (2) COST(-)(4)1. REFRIG UPGRADE \$ 248085. 0 1.00 248085. d. TOTAL \$ 248085. 248085. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 248085. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 16863. 5. SIMPLE PAYBACK PERIOD (1G/4) 9.09 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 314750. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =2.05 (IF < 1 PROJECT DOES NOT QUALIFY)

* Project does not qualify for ECIP funding; 4,5,6 for information only.

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LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A2 ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 173287. B. SIOH 9531. C. DESIGN COST 10397. D. TOTAL COST (1A+1B+1C) \$ 193215. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 193215. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED MBTU/YR(2) FUEL SAVINGS(3) \$/MBTU(1) FACTOR(4) SAVINGS (5) A. ELECT S 6.28 529. 3322. 15.08 50098. B. DIST \$.00 0. 0. 18.57 0. .00 C. RESID \$ 0. 0. 21.02 0. D. NAT G S 2.66 0. 0. 0. 18.58 .00 0. E. COAL \$ 0. 16.83 0. 0. F. PPG \$.00 0. 17.38 0. M. DEMAND SAVINGS 3167. 14.88 47125. N. TOTAL 529. \$ 6489. 97223. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) YR DISCNT DISCOUNTED OC FACTR SAVINGS(+)/ SAVINGS(+) COST(-) OC ITEM (1) (2) (3) COST(-)(4)1. REFRIG UPGRADE \$ 248085. 1.00 248085. d. TOTAL \$ 248085. 248085. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 248085. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 18893. 5. SIMPLE PAYBACK PERIOD (1G/4) 10.23 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 345308. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =(IF < 1 PROJECT DOES NOT QUALIFY)

** Project does not qualify for ECIP funding; 4,5,6 for information only.

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ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A3 ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 141037. B. SIOH \$ 7757. C. DESIGN COST 8462. D. TOTAL COST (1A+1B+1C) \$ 157256. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 157256. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS (5) A. ELECT \$ 434. 6.28 2726. 15.08 41101. .00 B. DIST S 0. \$ 0. 18.57 0. .00 C. RESID \$ \$ 0. 0. 21.02 0. D. NAT G \$ 2.66 0. \$ 0. 18.58 0. \$ E. COAL \$.00 0. 0. 16.83 0. F. PPG .00 Ο. 17.38 0. 0. 2520. M. DEMAND SAVINGS 14.88 37498. N. TOTAL 434. 5246. 78598. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-)Ŝ 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED COST(-) ITEM OC FACTR SAVINGS(+)/ (1) (2) (3) COST(-)(4)1. REFRIG UPGRADE \$ 248085. 1.00 0 248085. d. TOTAL \$ 248085. 248085. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 248085. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 17650. 5. SIMPLE PAYBACK PERIOD (1G/4) 8.91 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 326683. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =2.08 (IF < 1 PROJECT DOES NOT QUALIFY) Project does not qualify for ECIP funding; 4,5,6 for information only.

LIFE CYCLE COST ANALYSIS SUMMARY

D-17

STUDY: FSH

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH PROJECT NO. & TITLE: 03018504 REGION NOS. 6 CENSUS: 3 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A4 ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 313837. B. SIOH Ś 17261. C. DESIGN COST \$ 18830. D. TOTAL COST (1A+1B+1C) \$ E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 349928. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS(5) A. ELECT \$ 1516. 6.28 9520. 15.08 143569. B. DIST \$.00 0. 0. 18.57 0. -3386. 0. 0. .00 \$ 0. \$ -9007. C. RESID \$ 21.02 0. 2.66 D. NAT G \$ 18.58 -167346. .00 E. COAL \$ 0. 16.83 0. \$ 0. \$ 10987. \$ 11501. F. PPG .00 0. 17.38 0. M. DEMAND SAVINGS Ŝ 14.88 163487. N. TOTAL -1870. 139710. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED ITEM COST(-) OC FACTR SAVINGS(+)/ (1) (2) (3) COST(-)(4)1. REFRIG UPGRADE \$ 248085. 1.00 0 248085. d. TOTAL \$ 248085. 248085. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 248085. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 23905. 5. SIMPLE PAYBACK PERIOD (1G/4) 14.64 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 387795. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =1.11 (IF < 1 PROJECT DOES NOT QUALIFY)

** Project does not qualify for ECIP funding; 4,5,6 for information only.

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ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:

C

DATE:

8/13/95

ECO TITLE:

Replace Existing Central Chillers With New Electric Centrifugal Chiller

INSTALLATION:

Fort Sam Houston, San Antonio, Texas

LOCATION:

Area 1300, Building 1377

A. Summary:

Electrical Energy Savings	3,424	MMBTU/yr
Electrical Demand Savings	13,914	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	3,424	MMBTU/yr
Total Cost Savings	56,936	\$/yr
Total Investment	479,191	\$
Simple Payback	8.4	yrs
SIR	1.98	

B. ECO Description:

Remove the two 600 ton, R-11 centrifugal chillers in building 1377 which were installed in 1972, and replace them with one R-134 centrifugal chiller, rated at 827 tons. The two existing chilled water pumps and condenser water pumps serving the existing chillers should be removed. Install a new chilled water pump and a new condenser water pump, each rated at 75 HP, to serve the new chiller. The new chiller should be connected into the distribution piping at the existing location. New chilled water supply and return headers should be installed to join together the existing distribution systems serving building 1350 and the other seven buildings in the 1300 area. This will create a single chilled water distribution system to be served by the new chiller and the existing 438 ton chiller which was installed in 1983 to serve building 1350. All existing controls and electrical services should be reconnected where possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chillers and pumps, and installation of the new chillers, pumps, associated wiring and controls.

C. Discussion:

There are currently two independent chilled water distribution systems serving the 1300 area, one for building 1350 and the other for seven other buildings. These two systems should be combined into one system to conserve energy in the central plant. This can be accomplished by installing common CHW supply and return headers in the central plant. The existing centrifugal chiller serving building 1350 was installed in 1983, is rated at 438 tons and appears to be in good condition. The two existing centrifugal chillers serving the other seven buildings were installed in 1972, are rated at 600 tons each, and appear to be near the end of their useful life. Also, all three chillers use the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996¹. To avoid the anticipated increasing operational costs over the life of these machines, they should either be retrofitted to use an approved refrigerant or replaced with new machines that operate on one. The existing centrifugal machines can be retrofitted with no loss of capacity by replacing the impellers with new ones designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates². However, since the older machines are already over twenty years old, it is recommended that the facility replace them instead. A life cycle cost analysis performed on four different types of

replacement chillers available determined that a single electric centrifugal chiller using R-134 would be the most economical choice over the life of the machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 1,638 tons is more than what is required to adequately cool the buildings³. Therefore, the new combined capacity is recommended to be 1,265 tons to more nearly match the building cooling load.

D. Savings Calculations:

1. Energy Consumption And Savings

The monthly peak demand and energy consumptions of the existing and proposed alternative chillers and auxiliary equipment were calculated using the Trace 600 computer program⁴. The buildings served by the existing chillers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models⁵.

The 827 ton chiller alternatives which were compared included an electric centrifugal machine, an electric centrifugal with a variable frequency drive, a dual screw machine and a gas driven centrifugal machine. All proposed machines used R-134. Full load performance data from York International were used in the computer simulations of the new chiller energy usages⁶. Equipment lists of the specific chillers and auxiliaries for each alternative modeled by the computer are shown on pages E-22 to E-25.

Once the computer simulations were completed, the total annual demand cost and energy consumption of each alternative were compared with that of the existing systems to determine the annual savings for each⁷. These savings calculations are shown on pages E-26 through E-28. The demand and energy savings values were used in the life cycle cost analysis for each alternative. The results of these savings calculations were as follows:

Alternative	Chiller Type	Demand Savings \$/yr	Electrical Savings MMBTU/yr	Gas Savings MMBTU/yr
C 1	Electric Centrifugal	13,914	3,424	0
C2	Electric Centrifugal & VFD	14,532	3,615	0
С3	Electric Screw	11,345	3,250	0
C4	Gas Driven Centrifugal	38,536	6,386	-8,886

2. Maintenance Cost Savings:

By installing a new chiller in place of the two oldest existing ones, the installation will save the cost of retrofitting the machines for the HCFC-123 refrigerant as mentioned previously. The cost of this retrofit was estimated to be \$384,882 on page E-29. This value was used in the life cycle cost analysis as a non-recurring savings for each alternative.

E. Cost Estimates

The total installation costs for each alternative chiller mentioned in this ECO were estimated on pages E-30 through E-33. These costs were used in the life cycle cost analysis for each alternative. The results of the costs estimates were as follows:

Alternative	Chiller Type	Estimated Cost
C 1	Electric Centrifugal	\$479,191
C2	Electric Centrifugal & VFD	\$633,919
C3	Electric Screw	\$653,398
C4	Gas Driven Centrifugal	\$765,561

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on each chiller alternative for this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for each life cycle cost analysis is shown on pages E-34 through E-37. The results of the alternative life cycle cost analysis were as follows:

Alternative	Chiller Type	Payback Years	SIR
C1	Electric Centrifugal	8.4	1.98
C2	Electric Centrifugal & VFD	10.7	1.54
C3	Electric Screw	12.2	1.37
C4	Gas Driven Centrifugal	10.0	1.51

Since the electric centrifugal chillers have the highest SIR, they are recommended as the most economical choice to replace the existing machines. The data from the life cycle cost analysis for this alternative were included in the summary on page E-19.

REFERENCES

- 1. Per current EPA regulations on CFC refrigerants.
- 2. See Appendix G for chiller retrofit estimates from Northeastern Research And Engineering Corporation.
- 3. See Appendix B for Area 1300 cooling system load profile.
- 4. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 5. See Appendix C for building field data and existing HVAC system data.
- 6. See Appendix G for manufacturer's equipment performance data from York International.
- 7. See Appendix A for utility cost analysis data, used in the savings calculations.

ANNUAL USE	KWH MCF	517,565	867,974	85,104	151,513	63,828	151,513	141,358	37,204		
ES S	WKS	26	26	56	26	56	26	26	26		
OPER TIMES	DAYS	7	7	7	7	7	7	7	7		
OPP	HRS	24	24	24	24	24	24	24	24		
- 1	LOAD	329 KW	479 KW	29.84 KW	55.95 KW	22.38 KW	55.95 KW	52.22 KW	14.92 KW		
95 VEAR	INSTALLED	1983	New	1983	New	1983	New	Exist.	Exist.		
JUNE 2, 1995	AREA SERVED	Area 1300	Area 1300	Area 1300	Area 1300	Area 1300	Area 1300	Area 1300	Area 1300		
PROPOSED HVAC EQUIPMENT LIST FOR. ECO-CT, FORT SAME TOOSTON, SINCE 1995 JUNE 2, 1995 VEAR FILL OPER	DESCRIPTION	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	York, electric water cooled, centrifugal, 827 Tons, R-134a	Allis Chalmers 775 gpm, 114 ft 40 HP	1670 gpm, 114 ft 75 HP	Allis Chalmers 1314 gpm, 30 ft 30 HP	2785 gpm, 70 ft 75 HP	Marley #324T induced draft, 2-35 HP fans	Marley induced draft, 20 HP fan		
	QTY.	-	-	-	-	-	γ-	-	4		
	ITEM	Water Chiller	Water Chiller	Chilled Water Pump	Chilled Water Pump	Condenser Water Pump	Condenser Water Pump	Cooling Tower	Cooling Tower		

		П		T	1							
	ANNUAL USE	KWH MCF	517,565	811,935	85,104	151,513	63,828	151,513	141,412	37,204		
<u>.</u>	ES	WKS	26	26	56	56	56	56	56	26		
300	OPER. TIMES	DAYS	7	7	7	7	7	7	7	7		
AREA 1:	OP	HRS	24	24	24	24	24	24	24	24		
M HOUSTON,	FULL	LOAD	329 KW	479 KW	29.84 KW	55.95 KW	22.38 KW	55.95 KW	52.22 KW	14.92 KW		
c2, FORT SA	YEAR	INSTALLED	1983	New	1983	New	1983	New	Exist.	Exist.		
MENT LIST FOR: ECO-(AREA SERVED	Area 1300	Area 1300	Area 1300	Area 1300	Area 1300	Area 1300	Area 1300	Area 1300		
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-C2, FORT SAM HOUSTON, AREA 1300		DESCRIPTION	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	York, electric, VFD water cooled, centrifugal, 827 Tons, R-134a	Allis Chalmers 775 gpm, 114 ft 40 HP	1670 gpm, 114 ft 75 HP	Allis Chalmers 1314 gpm, 30 ft 30 HP	2785 gpm, 70 ft 75 HP	Marley #324T induced draft, 2-35 HP fans	Marley induced draft, 20 HP fan		
		ΩT₹.	-	-	-	-	~	-	-	-		
		ITEM	Water Chiller	Water Chiller	Chilled Water Pump	Chilled Water Pump	Condenser Water Pump	Condenser Water Pump	Cooling Tower	Cooling Tower		

	JUNE 2, 1995 TION AREA SERVED INSTALLED LOAD HRS DAYS WKS KWH MCF
TIMES ANNUAL ANNUAL ANNUAL ANNUAL ANNUAL ANNUAL ANNUAL ANNUAL AND	Area 1300 1983 329 KW 24 7 26 Area 1300 New 529 KW 24 7 26 Area 1300 New 55.95 KW 24 7 26 Area 1300 New 55.95 KW 24 7 26 Area 1300 New 55.95 KW 24 7 26 Area 1300 Exist. 52.22 KW 24 7 26 Area 1300 Exist. 52.22 KW 24 7 26

		PROPOSED HVAC EQUIPMENT LIST FOR: ECO-C4, FORT SAM HOUSTON, AREA 1300	MENT LIST FOR: EC	D-C4, FORT S	AM HOUSTON,	AREA 1	300		
				YEAR	FULL	Q	OPER. TIMES	ES	ANNUAL USE
ITEM	ΩT Y	DESCRIPTION	AREA SERVED	INSTALLED	LOAD	HRS	DAYS	WKS	KWH MCF
Water Chiller	-	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	Area 1300	1983	329 KW	24	7	56	517,565
Water Chiller	-	York, gas fired water cooled, centrifugal 827 Tons, R-134a	Area 1300	New	5,127 MBH	24	7	26	8,886
Chilled Water Pump	-	Allis Chalmers 775 gpm, 114 ft 40 HP	Area 1300	1983	29.84 KW	24	7	26	85,104
Chilled Water Pump	-	1670 gpm, 114 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513
Condenser Water Pump	-	Allis Chalmers 1314 gpm, 30 ft 30 HP	Area 1300	1983	22.38 KW	24	7	26	63,828
Condenser Water Pump	-	2785 gpm, 70 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513
Cooling Tower	-	Marley #324T induced draft, 2-35 HP fans	Area 1300	Exist.	52.22 KW	24	7	26	141,358
Cooling Tower	-	Marley induced draft, 20 HP fan	Area 1300	Exist.	14.92 KW	24	7	26	37,204

ITEM			1		ī	LY PEAK	DEMAN	D (KW)			1		ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					524.9	541.9	549.8	556.5	540.7	371.9			1,464,005	
Water Chiller					165.4	210.0	305.1	347.3	234.0				130,286	
Water Chiller					286.9	267.5	299.6	319.9	290.4	193.8			595,685	
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			131,773	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					29.8	29.8	29.8	29.8	29.8	29.8			131,773	
CND Pump					29.8	29.8	29.8	29.8	29.8				31,153	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			98,830	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			210,817	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9	_		60,215	
Totals					1193.3	1235.5	1370.6	1439.8	1281.2	752.0			3,019,253	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					8,950	12,355	13,706	14,398	12,812	5,640				

Total Demand

67,861 \$/yr

Total Energy

10,305 MMBTU/yr

(electric)

Total Energy

MMBTU/yr

(gas)

ITEM			ECO-(C1: NE	W ELE				AL CHI	LLER			ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	()	(,,,,,,
Water Chiller					268.8	287.1	326.8	330.2	307.2	276.6			517,565	
Water Chiller					437.4	453.1	475.2	479.0	446.8	373.4			867,974	
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			85,104	
CHW Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			63,828	
CND Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			37,204	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			141,358	
Total (KW)					937.5	971.5	1033.3	1040.5	985.3	881.3			2,016,059	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					7,031	9,715	10,333	10,405	9,853	6,610				

Total Demand

53,947 \$/yr

Demand Savings

13,914 \$/yr

Energy Savings

3,424 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

ITEM	Jan	ECO Feb	-C2: N	EW EL	ECTRIC MONTH				HILLER Sep	WITH	VFD Nov	Dec	ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
Water Chiller	Jun	100	Wildi	7,61	268.8	287.1	326.8	330.2	307.2	276.6	1101		517,565	
Water Chiller					419.5	441.7	472.9		437.2	340.0			811,935	
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			85,104	
CHW Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			63,828	
CND Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			37,204	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			141,412	
Total (KW)					919.6	960.1	1031.0	1040.5	975.7	847.9			1,960,074	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					6,897	9,601	10,310	10,405	9,757	6,359				

Total Demand

53,329 \$/yr

Demand Savings

14,532 \$/yr

Energy Savings

3,615 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

(gas)

ITEM			EC	CO-C3:		ELECT LY PEAK			CHILLE	:R			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					268.8	287.1	326.8	330.2	307.2	276.6			517,565	
Water Chiller					483.0	500.4	524.8	529.0	493.4	412.3			916,945	
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			85,104	
CHW Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			63,828	
CND Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			37,204	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			143,448	
Total (KW)					983.1	1018.8	1082.9	1090.5	1031.9	920.2			2,067,120	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					7,373	10,188	10,829	10,905	10,319	6,902				

Total Demand

56,516 \$/yr

Demand Savings

11,345 \$/yr

Energy Savings

3,250 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

ITEM		E	ECO-C4	4: NEV		ENGIN LY PEAK			GAL CH	HILLER			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					268.8	287.1	326.8	330.2	307.2	276.6			517,565	
Water Chiller														8,886
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			85,104	
CHW Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			63,828	
CND Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			37,204	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			141,358	
Total (KW)					500.1	518.4	558.1	561.5	538.5	507.9			1,148,085	8,886
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					3,751	5,184	5,581	5,615	5,385	3,809				

Total Demand

29,325 \$/yr

Demand Savings

38,536 \$/yr

Energy Savings

6,386 MMBTU/yr

(electrical)

Energy Savings

-8,886 MMBTU/yr

ENGINEER'S ESTIM	ATE	PF	PRC	BAB	ESTIMATE OF PROBABLE COST	ST		
LOCATION:		PROJECT NO:	T NO:		03-0185.04		DATE:	8/16/95
AKEA 1300, BUILDING 1377, FORT SAM HOUSTON		BY:	PIEPER, C.A.	C.A.		СН	CHECKED BY:	KLK
PROJECT DESCRIPTION: ECO-C, Upgrade Two Existing R-11 Chillers To Operate On R-123	Chillere	5 To Ope	rate 0	n R-123				
	QUAN	QUANTITY		LABOR	٤	MATERIAL	IIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Retrofit of two existing R-11 chillers to use R-123	-	e e	160	\$28.00	\$4,480	\$275,000	\$275,000	\$279,480
R-123 detection evetem	-	JOB				\$5,000	\$5,000	\$5,000
Chiller 2 speed ventilation fan	-	<i>a</i>	10	\$25.00	\$400	\$1,185	\$1,185	\$1,585
	5	400	4	\$28.00	\$1120	507	\$270	\$1,390
Chiller ventilation louver	2	2 50						
Test & Balance	-	e a	4	\$50.00	\$200			\$200
			1	CHRTOTAL	\$6,000		\$281455	\$287.655
		1		10000	0.01		2000	477774
HUITT-ZOLLARS. INC.		٥	& P @ 20%	%	\$1,240		\$20°,73°	100,70\$
FINDINEERS / ARCHITECTS			S	SUBTOTAL	\$7,440		\$337,746	\$345,186
512 MAIN STREET SUITE 1500		DE	DESIGN @ 6%	%9				\$20,711
FORT WORTH, TEXAS 76102-3922			S	SUBTOTAL				\$365,897
(817) 335-3000 * FAX (817) 335-1025		SI	SIOH @ 5.5%	%!				\$18,985

TOTAL

ENGINEER'S ESTIMATI	ESTIMATE OF PROBABLE COST	BLE COST		
LOCATION:	PROJECT NO:	03-0185.04	DATE:	8/16/95
AKEA 1300, BUILDING 1377, FORT SAM HOUSTON	BY: PIEPER, C.A.		CHECKED BY:	KLK

Chiller
Centrifugal
Cooled
w Water
With Ne
Chillers
Central
: Existing
Replace
ECO-C1,
PROJECT DESCRIPTION:

	QUANTITY	YTITY		LABOR	~	MATERIAL	NAL	10101
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove Pumps	2	EA	0	\$24.64	\$296			\$296
Remove chillers	2	EA	4	\$24.64	\$1,971	\$500	\$1,000	\$2,971
Install New Chiller 827 ton, water cooled, centrifugal, R-134a	-	EA	2,609	\$24.64	\$64,286	\$226,800	\$226,800	\$291,086
Pipe Assembly And Valves	-	EA	168	\$24.64	\$4,140	\$10,000	\$10,000	\$14,140
RECONNECT:								
Controls	-	JOB	190	\$24.64	\$4,682	\$400	\$400	\$5,082
Electrical	-	JOB	95	\$24.64	\$2,267	\$800	\$800	\$3,067
Refrigerant Detection System	-	JOB	20	\$24.64	\$493	\$4,500	\$4,500	\$4,993
Water Pump 75 HP	2	EA	132	\$24.64	\$6,505	\$13,500	\$27,000	\$33,505
Test & Balance and Start-up	-	JOB	100	\$28.00	\$2,800	\$200	\$200	\$3,000
			0,	SUBTOTAL	\$87,440		\$270,700	\$358,140

FORT WORTH, TEXAS 76102-3922 (817) 335-3000 * FAX (817) 335-1025 HUITT-ZOLLARS, INC. **ENGINEERS / ARCHITECTS** 512 MAIN STREET, SUITE 1500

\$23,637 \$479,191

\$25,786

\$455,554

\$71,628 \$429,768

\$54,140 \$324,840

\$17,488 \$104,928

O&P@20%

SUBTOTAL

DESIGN @ 6%

SUBTOTAL

SIOH @ 5.5%

TOTAL

ENGINEER'S ESTIMATE OF PROBABLE COST

AREA 1300, BUILDING 1377, FORT SAM HOUSTON LOCATION:

CHECKED BY: DATE: 03-0185.04 PROJECT NO:

PIEPER, C.A. BY:

KLK

8/16/95

ECO-C2, Replace Existing Central Chiller With New Centrifugal Chiller And Variable Frequency Drive (VFD) PROJECT DESCRIPTION:

	QUA	QUANTITY		LABOR	2	MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove Pumps	2	EA	0	\$24.64	\$296			967\$
Semove chillers	2	EA	40	\$24.64	\$1,971	\$500	\$1,000	\$2,971
Install New Chiller 827 ton, water cooled, centrifugal, R-134a		EA	2,609	\$24.64	\$64,286	\$226,800	\$226,800	\$291,086
Adder For VED	1000	<u>4</u>				\$115	\$115,000	\$115,000
Pipe Assembly And Valves	-	EA	168	\$24.64	\$4,140	\$10,000	\$10,000	\$14,140
RECONNECT:								
Controls	-	JOB	190	\$24.64	\$4,682	\$400	\$400	\$5,082
1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	_	306	118	\$24.64	\$2,908	\$800	\$800	\$3,708
Refrigerant Detection System		JOB	20	\$24.64	\$493	\$4,500	\$4,500	\$4,993
Water Pump 75 HP	2	EA	132	\$24.64	\$6,505	\$13,500	\$27,000	\$32,505
Test & Balance and Start-up	-	JOB	100	100 \$28.00	\$2,800	\$200	\$200	\$3,000
				SUBTOTAL	\$88,081		\$385,700	\$473,781

HUITT-ZOLLARS, INC. **ENGINEERS / ARCHITECTS**

\$34,112

\$568,537

\$602,649 \$31,270 \$633,919

TOTAL

SUBTOTAL

SIOH @ 5.5%

\$94,756

\$77,140 \$462,840

\$17,616 \$105,697

O&P@20%

SUBTOTAL

DESIGN @ 6%

(817) 335-3000 * FAX (817) 335-1025 512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922

	ENGINEER'S ESTIMATE	ESTIMATE OF PROBABLE COST	BLE COST		
LOCATION:		PROJECT NO:	03-0185.04	DATE:	8/16/95
AREA 1300, BUILDING 1377, FORT SAM HOUSTON	W, FORT SAM HOUSTON	BY: PIEPER, C.A.		CHECKED BY:	KLK
PROJECT DESCRIPTION:	ECO-C3, Replace Existing Central Chillers With New Water Cooled Dual Screw Chillere	rs With New Water Coc	oled Dual Screw Chille	5	

	QUAI	QUANTITY		LABOR	~	MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove Plima	2	EA	0	\$24.64	\$296			\$296
Remove chillers	2	EA	40	\$24.64	\$1,971	\$500	\$1,000	\$2,971
Install New Chiller 827 ton, water cooled, dual screw, R-134a	-	EA	2,609	\$24.64	\$64,286	\$357,000	\$357,000	\$421,286
Pine Assembly And Valves	-	EA	168	\$24.64	\$4,140	\$10,000	\$10,000	\$14,140
RECONNECT:								
Controls	-	JOB	190	\$24.64	\$4,682	\$400	\$400	\$5,082
Eectrica	-	JOB	92	\$24.64	\$2,267	\$800	\$800	\$3,067
Refrigerant Detection System	-	JOB	50	\$24.64	\$493	\$4,500	\$4,500	\$4,993
Water Pump 75 HP	2	EA	132	\$24.64	\$6,505	\$13,500	\$27,000	\$33,505
Test & Balance and Start-up	-	JOB	100	\$28.00	\$2,800	\$200	\$200	\$3,000
							00000.4	4100 1710

HUITT-ZOLLARS, INC. ENGINEERS / ARCHITECTS 512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922 (817) 335-3000 * FAX (817) 335-1025

\$97,668 \$586,008 \$35,160 \$621,168 \$32,230 \$653,398

\$488,340

\$400,900 \$80,180 \$481,080

\$87,440 \$17,488 \$104,928

SUBTOTAL

O&P@20%

SUBTOTAL

DESIGN @ 6%

SUBTOTAL

SIOH @ 5.5%

TOTAL

ENGINEER'S ESTIN	IAT	EOF	PR	JBAB	ESTIMATE OF PROBABLE COST	ST		
LOCATION:		PROJE	PROJECT NO:		03-0185.04		DATE:	8/16/95
AKEA 1300, BUILDING 1377, FOKI SAM HOUSION		BY:	PIEPER, C.A.	C.A.		S	CHECKED BY:	KLK
PROJECT DESCRIPTION: ECO-C4, Replace Existing Central Chillers With New Gas Engine Driven Chillere	l Chiller	rs With	New Gae	s Engine D	riven Chiller	ė		
	QUA	QUANTITY		LABOR	2	MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove Pumps	2	EA	0	\$24.64	\$296			\$296
Remove chillers	2	EA	40	\$24.64	\$1,971	\$500	\$1,000	\$2,971
Let all Naw Chillen 207 + on water cooled centrifical R-1842 and fired		П	609 6	\$24.64	\$64.286	\$436.800	\$436.800	\$501,086
	-	i	ĵ					
Pipe Assembly And Valves	-	EA	168	\$24.64	\$4,140	\$10,000	\$10,000	\$14,140
RECONNECT:	•	2	,	10 V C#	A 680	4400	\$400	45,080
Controls	-	305	8	\$24.64	\$2.267	\$800	\$800	\$3,067
וויסטדו וכמו								
Refrigerant Detection System	-	JOB	20	\$24.64	\$493	\$4,500	\$4,500	\$4,993
Water Pump 75 HP	2	EA	132	\$24.64	\$6,505	\$13,500	\$27,000	\$33,505
GAS PIPING		JOB	95	\$24.64	\$1,528	\$2,500	\$2,500	\$4,028
							0001	000
Test & Balance and Start-up	-	JOB	100	\$28.00	_1	\$200	\$200	\$3,000
				SUBTOTAL	\$88,968		\$483,200	\$572,168
	- 							

ENG 512 FORT

HUITT-ZOLLARS, INC.
ENGINEERS / ARCHITECTS
512 MAIN STREET, SUITE 1500
FORT WORTH, TEXAS 76102-3922
(817) 335-3000 * FAX (817) 335-1025

\$114,434

\$96,640

\$17,794

O&P@20%

SUBTOTAL

DESIGN @ 6%

SUBTOTAL

SIOH @ 5.5%

TOTAL

\$41,196 \$727,798 \$37,763 \$765,561

\$686,602

LCCID FY95 (92) ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) INSTALLATION & LOCATION: FSH
PROJECT NO. & TITLE: 03018504 REGION NOS. 6 CENSUS: 3 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C1 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER ANALYSIS DATE: 1. INVESTMENT A. CONSTRUCTION COST 429768. B. SIOH \$ 23637. \$ C. DESIGN COST 25786. D. TOTAL COST (1A+1B+1C) \$ 479191. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. 0. F. PUBLIC UTILITY COMPANY REBATE 479191. G. TOTAL INVESTMENT (1D - 1E - 1F) 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL MBTU/YR(2) SAVINGS(3) FACTOR(4) \$/MBTU(1) SAVINGS (5) 3424. 21503. 324261. A. ELECT S 6.28 15.08 B. DIST \$ 0. 18.57 .00 0. 0. .00 C. RESID \$ 0. 0. 21.02 0. D. NAT G \$ 0. 0. 18.58 2.66 0. E. COAL S .00 0. 0. 16.83 0. 0. F. PPG 17.38 .00 0. 0. 13914. M. DEMAND SAVINGS 14.88 207040. 3424. \$ 35417. 531301. N. TOTAL 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-)2275. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 33852. B. NON RECURRING SAVINGS(+) / COSTS(-) YR DISCNT DISCOUNTED SAVINGS(+) SAVINGS(+)/ COST(-) FACTR ITEM OC (3) (1) (2) COST(-)(4)1. REFRIG UPGRADE \$ 384882. 0 1.00 384882. d. TOTAL \$ 384882. 384882. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 418734. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 56936. 8.42 YEARS 5. SIMPLE PAYBACK PERIOD (1G/4) 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 950035. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =1.98 (IF < 1 PROJECT DOES NOT QUALIFY) 6.59 % 8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FSH

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) REGION NOS. 6 CENSUS: 3 INSTALLATION & LOCATION: FSH PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C2 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER ANALYSIS DATE: 1. INVESTMENT A. CONSTRUCTION COST 568537. \$ B. SIOH 31270. C. DESIGN COST 34112. D. TOTAL COST (1A+1B+1C) \$ 633919. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 633919. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS DISCOUNT DISCOUNTED ANNUAL \$ FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS (5) A. ELECT \$ 6.28 3615. 22702. 15.08 342349. B. DIST \$.00 0. 0. 18.57 0. C. RESID \$ 0. 0. 21.02 .00 0. 0. 18.58 D. NAT G \$ 2.66 0. 0. .00 E. COAL 0. 0. 16.83 0. F. PPG \$ \$ 0. \$ 14532. 17.38 .00 0. 0. M. DEMAND SAVINGS 14.88 216236. 3615. \$ 37234. 558585. N. TOTAL 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 2275. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 33852. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED TTEM COST(-) OC FACTR SAVINGS(+)/ (2) COST(-)(4)(1) (3) 0 1. REFRIG UPGRADE \$ 384882. 1.00 384882. d. TOTAL \$ 384882. 384882. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 418734. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 58753. 10.79 YEARS 5. SIMPLE PAYBACK PERIOD (1G/4) 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 977319. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =1.54 (IF < 1 PROJECT DOES NOT QUALIFY) 8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.25 %

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FSH

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH LCCID FY95 (92) ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) REGION NOS. 6 CENSUS: 3 INSTALLATION & LOCATION: FSH PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C3 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER ANALYSIS DATE: 1. INVESTMENT 586008. A. CONSTRUCTION COST \$ B. SIOH 32230. 35160. C. DESIGN COST D. TOTAL COST (1A+1B+1C) \$ 653398. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. 0. F. PUBLIC UTILITY COMPANY REBATE 653398. G. TOTAL INVESTMENT (1D - 1E - 1F) 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 DISCOUNT DISCOUNTED UNIT COST SAVINGS ANNUAL \$ \$/MBTU(1) FACTOR (4) MBTU/YR(2) SAVINGS(3) SAVINGS (5) FUEL A. ELECT \$ 6.28 3250. 20410. 15.08 307783. B. DIST .00 0. 18.57 0. 0. 0. 0. 21.02 0. C. RESID \$.00 18.58 0. 0. 0. D. NAT G \$ 2.66 .00 0. 16.83 E. COAL 0. F. PPG 17.38 \$.00 0. 0. 0. 11345. 14.88 168814. M. DEMAND SAVINGS 3250. 31755. 476596. N. TOTAL 3. NON ENERGY SAVINGS(+) / COST(-) 2275. A. ANNUAL RECURRING (+/-)(1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 33852. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED COST(-) FACTR SAVINGS(+)/ ITEM OC (2) COST(-)(4)(1) (3) 1.00 384882. 1. REFRIG UPGRADE \$ 384882. \$ 384882. 384882. d. TOTAL C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 418734. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 53274. 12.26 YEARS 5. SIMPLE PAYBACK PERIOD (1G/4) 895330. 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) (SIR) = (6 / 1G) =1.37 7. SAVINGS TO INVESTMENT RATIO (IF < 1 PROJECT DOES NOT QUALIFY) *** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):

N/A

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C4 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER ANALYSIS DATE: 1. INVESTMENT A. CONSTRUCTION COST 686602. B. SIOH \$ 37763. C. DESIGN COST 41196. 765561. D. TOTAL COST (1A+1B+1C) \$ E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 765561. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED MBTU/YR(2) FUEL \$/MBTU(1) SAVINGS(3) FACTOR(4) SAVINGS (5) A. ELECT S 6.28 6386. 40104. 15.08 604770. .00 B. DIST 0. 0. 18.57 0. C. RESID S .00 0. 0. 21.02 0. -8880 0. 0. D. NAT G \$ -23637. 2.66 18.58 -439171. .00 E. COAL \$ 0. 16.83 0. F. PPG .00 0. 17.38 0. M. DEMAND SAVINGS 38536. 14.88 573416. 739014. 55003. N. TOTAL -2500. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 2275. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 33852. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED OC FACTR COST(-) SAVINGS(+)/ (1) (2) (3) COST(-)(4)\$ 384882. 1. REFRIG UPGRADE 1.00 384882. d. TOTAL \$ 384882. 384882. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 418734. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 76522. 10.00 YEARS 5. SIMPLE PAYBACK PERIOD (1G/4) 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1157748. 1.51 (SIR) = (6 / 1G) =7. SAVINGS TO INVESTMENT RATIO (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO: D

DATE: 6/15/95

ECO TITLE: Replace Existing Central Boilers With High Efficiency Modular Boilers

INSTALLATION: Fort Sam Houston, San Antonio, Texas

LOCATION: Area 1300, Building 1377

A. Summary:

Electrical Energy Savings 712 MMBTU/yr **Electrical Demand Savings** 1.847 \$/vr Gas Energy Savings 4,020 MMBTU/yr **Total Energy Savings** 4,732 MMBTU/yr **Total Cost Savings** 17,012 \$/yr **Total Investment** 163,724 \$ Simple Payback 9.6 yrs SIR 1.79

B. ECO Description:

Remove the two existing watertube boilers and single 40 HP heating water (HW) distribution pump in building 1377, which are serving building 1350. Also remove the two existing firetube boilers and the two 15 HP distribution pumps in building 1377 which serve buildings 1374, 1375, 1379, 1380, 1382, 1377 and 1385. Connect the two separate distribution loops together in building 1377 with new HW supply and return headers to make a single HW distribution system. Install four new modular high efficiency boilers, rated at 1,830 MBH output each and four new 7 ½ HP distribution pumps to serve this single system. The existing electrical service and controls should be reused as much as possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. The boilers and pumps should be sequenced to operate only as needed to maintain the supply water temperature setpoint of approximately 180°F. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and pumps, and installation of the new boilers, pumps, associated wiring and controls.

C. Discussion:

The two existing watertube boilers serving building 1350 were installed in 1983 and are rated at 5,317 MBH and 4,336 MBH output capacity. The single 40 HP pump circulates HW from these boilers through building 1350. The two existing firetube boilers serving the other buildings in the 1300 area were installed in 1972 and are rated at 5,912 MBH output capacity each. Two 15 HP pumps circulate HW from these boilers to the seven other buildings listed above. All these boilers appear to be in fair condition. Computer simulations of the eight buildings served by these boilers determined that the current combined capacity of 21,477 MBH is about three times the amount required to adequately heat the buildings¹. The existing boilers are therefore operating at an inefficient, low load condition most of the time. Also, because of the constant flow rate requirements of the large boilers, excessive pumping energy is expended. By combining the two distribution systems together and staging four new high efficiency modular boilers to operate only as needed, a substantial energy savings can be realized. Also, a decrease in the combined boiler output capacity to 7,320 MBH is recommended to more closely match the heating load in the eight buildings and reduce the associated pumping energy consumption.

D. Savings Calculations:

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pumps were calculated using the Trace 600 computer program². The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models³.

The four new high efficiency, modular type boilers modeled were rated at 1,830 MBH output each. Full and part load performance data from Aerco International were used in the computer simulations of the new boiler energy usages⁴. An equipment list with specific data on the new boilers and pumps used in the computer simulation is shown on page D-40.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings⁵. These savings calculations are shown on page D-41. The demand and energy savings values were used in the life cycle cost analysis for this ECO. The results of these savings calculations were as follows:

New Boiler Type	Gas	Electrical	Demand
	Savings	Savings	Savings
	MMBTU/yr	MMBTU/yr	\$/yr
Modular, High Efficiency	4,020	712	1,847

E. Cost Estimates

The total installation costs for this ECO were estimated on page D-42. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page D-43. The data from the life cycle cost analysis were included in the summary on page D-38.

REFERENCES

- 1. See Appendix for Area 1300 heating system load profile.
- 2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 3. See Appendix C for building field data and existing HVAC system data.
- 4. See Appendix G for manufacturer's equipment performance data from Aerco International.
- 5. See Appendix A for utility cost analysis data, used in the savings calculations.

	щ	MCF	14,731								
	ANNUAL USE	Σ	₩.								
	ANNU	CWH		50,529							
	Ц										
	MES	WKS	26	26							
300	OPER. TIMES	DAYS	7	7							
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-D, FORT SAM HOUSTON, AREA 1300 JUNE 2, 1995	g	HRS	24	24							
TON, A			МВН	X K							
HOUS	FULL	LOAE	2,000 MBH	5.60 KW							
SAM		0									
FORT	YEAR	INSTALLED	New	New							
CO-D,	>	.SNI		_							
OR: E(VFD										
IST FC	ARFA SFRVFD		8	00			:				
AENT 1	ARE		Area 1300	Area 1300				:			
QUIPA			- ∢	⋖							
VAC E	NOI		3WB rtube								
SED H	DESCRIPTION		Aerco #KC-2000 GWB natural draft, watertube 1830 MBH output	o ft		•					
ROPOS	DES		o #KCral draf	Aurora 100 gpm, 80 ft 7.5 HP							
Ā			Aero natu 1830	Aurora 100 gpr 7.5 HP							
	ΩT		4	4							
			iler	dwn							
	ITEM		iter Bo	Vater F	,	,	·				
r.			Hot Water Boiler	Heating Water Pump							
*80%			1.	Fe							

1300 AREA

ITEM				EXIS		ENTR/ LY PEAK			_ANT				ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Watertube Boiler			,											3,140
Firetube Boiler	7.5	7.5	7.5	7.5							7.5	7.5	32,406	15,611
HW Pump	29.8	29.8	29.8	29.8							29.8	29.8	129,625	
HW Pump	11.2	11.2	11.2	11.2							11.2	11.2	48,609	
HW Pump	11.2	11.2	11.2	11.2							11.2	11.2	48,609	
Totals	59.7	59.7	59.7	59.7							59.7	59.7	259,249	18,751
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	448	448	448	448						1	448	448		

Total Demand

2,687 \$/yr

Total Energy

885 MMBTU/yr

(electric)

Total Energy

18,751 MMBTU/yr

(gas)

ITEM		ECO-[D: NEV	V CEN			FFICIE DEMAN		ODULA	R BOII	LERS		ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Modular Boiler														8,632
Modular Boiler														3,976
Modular Boiler														1,919
Modular Boiler														204
HW Pump	5.6	5.6	5.6	5.6							5.6	5.6	24,326	
HW Pump	5.6	5.6	5.6	5.6							5.6	5.6	15,742	
HW Pump	5.6	5.6	5.6								5.6	5.6	7,504	
HW Pump	5.6	5.6										5.6	2,957	
Total (KW)	22.4	22.4	16.8	11.2							16.8	22.4	50,529	14,731
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10,00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	168	168	126	84							126	168	1	

Total Demand

840 \$/yr

Demand Savings

1,847 \$/yr

Energy Savings

712 MMBTU/yr

(electric)

Energy Savings

4,020 MMBTU/yr

ENGINEER'S ESTIMATE OF PROBABLE COST	ATE	P	PR(BAB	LE CO	ST		
LOCATION:		PROJECT NO:	CT NO:)	03-0185.04		DATE:	6/16/95
ANEA 1900, DUILDING 1977, LONI BANK HOUBION		BY:	PIEPER, C.A.	C.A.		СН	СНЕСКЕВ ВҮ:	KLK
PROJECT DESCRIPTION: ECO-D, Replace Existing Central Boilers With High Efficiency Modular Boilers	oilers	With Hig	gh Effic	iency Mod	ular Boiler	S		
	QUA	QUANTITY		LABOR		MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove Boilers	4	EA	00	\$24.64	\$5,914	\$500	\$2,000	\$7,914
Remove Pumps	3	EA	0	\$24.64	\$444			\$444
Install New Boilers, AERCO # KC 2000 GWB, Water Tube 1830 MBH	4	EA	80	\$24.64	\$7,885	\$18,000	\$72,000	\$79,885
Install New Pump	4	EA	11	\$24.64	\$1,084	\$1,670	\$6,680	\$7,764
pipe Assembly & valves Boiler	4	JOB	28	\$24.64	\$2,760	\$2,400	\$9,600	\$12,360
pipe Assembly & valves Pump	4	EA	6	\$24.64	\$887	\$350	\$1,400	\$2,287
Boiler Breaching Stainless Steel	40	LF	2	\$24.64	\$1,971	\$147	\$5,880	\$7,851
Reconnect Controls	4	JOB	5	\$24.64	\$386	\$55	\$220	\$1,206
Reconnect Electrical	4	JOB	9	\$26.64	\$629	\$64	\$256	\$895
Reconnect Chemical system	4	JOB	D	\$26.64	\$533	\$50	\$200	\$733
Teet, Balance & Start-up	4	S	0	\$25.64	\$1,026			\$1,026
				SUBTOTAL	\$24,129		\$98,236	\$122,365

\$8,810

\$24,473

\$19,647

\$4,826 \$28,955

O&P@20%

SUBTOTAL

DESIGN @ 6%

\$8,076

\$163,724

TOTAL

SUBTOTAL

512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922 (817) 335-3000 * FAX (817) 335-1025

ENGINEERS / ARCHITECTS

SIOH @ 6.6%

\$155,648

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-D 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER ANALYSIS DATE: 1. INVESTMENT A. CONSTRUCTION COST 146838. B. SIOH \$ 8076. C. DESIGN COST \$ 8810. D. TOTAL COST (1A+1B+1C) \$ 163724. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 163724. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL MBTU/YR(2) \$/MBTU(1) SAVINGS(3) FACTOR(4) SAVINGS (5) A. ELECT S 6.28 712. 4471. 15.08 67428. .00 B. DIST 0. 0. 18.57 0. C. RESID \$.00 0. 0. 21.02 0. 10693. D. NAT G S 2.66 4020. 198680. 18.58 .00 0. E. COAL S 0. 16.83 0. 0. F. PPG .00 0. 17.38 0. M. DEMAND SAVINGS 1847. 14.88 27483. N. TOTAL 4732. \$ 17012. 293591. 3. NON ENERGY SAVINGS (+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED COST(-) ITEM OC FACTR SAVINGS(+)/ (1)(3) (2) COST(-)(4)d. TOTAL 0. 0. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 0. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 17012. 5. SIMPLE PAYBACK PERIOD (1G/4) 9.62 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 293591. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =1.79 (IF < 1 PROJECT DOES NOT QUALIFY)

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO: E

DATE: 6/15/95

ECO TITLE: Replace Existing Central Chiller With New Electric Centrifugal Chiller

INSTALLATION: Fort Sam Houston, San Antonio, Texas

LOCATION: Area 2200, Building 2265

A. Summary:

Electrical Energy Savings	1,304	MMBTU/yr
Electrical Demand Savings	11,822	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	1,304	MMBTU/yr
Total Cost Savings	37,433	\$/yr
Total Investment	237,078	\$
Simple Payback	6.3	yrs
SIR	2.73	

B. ECO Description:

Remove the existing 675 ton, R-11 centrifugal chiller in building 2265 and replace it with a 555 ton, R-134a centrifugal chiller. The existing 100 HP chilled water (CHW) pump, 50 HP condenser water (CND) pump and 40 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

C. Discussion:

The existing water cooled, centrifugal chiller was installed in 1973 and serves as the primary cooling system for the four large buildings in the 2200 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996¹. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates². However, since the machine is already 22 years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that an electric centrifugal chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 657 tons is more than what is required to adequately cool the buildings³. Therefore, the new chiller should only be sized for 555 tons to more closely match the cooling load of the four buildings.

D. Savings Calculations:

1. Energy Consumption And Savings

The monthly peak demand and energy consumptions of the existing and proposed alternative chillers and auxiliary equipment were calculated using the Trace 600 computer program⁴. The buildings served by the existing chiller were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models⁵.

The 555 ton chiller alternatives which were compared included an electric centrifugal machine, an electric centrifugal with a variable frequency drive, a dual screw machine and a gas driven centrifugal machine. All proposed machines used R-134a. Full and part load performance data from York International were used in the computer simulations of the new chiller energy usages⁶. Equipment lists of the specific chillers and auxiliaries for each alternative modeled by the computer are shown on pages D-47 To D-50.

Once the computer simulations were completed, the total annual demand cost and energy consumption of each alternative were compared with that of the existing systems to determine the annual savings for each⁷. These savings calculations are shown on pages D-51 and D-52. The demand and energy savings values were used in the life cycle cost analysis for each alternative. The results of these savings calculations were as follows:

Alternative	Chiller Type	Demand Savings \$/yr	Electrical Savings MMBTU/yr	Gas Savings MMBTU/yr
E 1	Electric Centrifugal	11,822	1,304	0
E2	Electric Centrifugal & VFD	12,188	1,498	0
E3	Electric Screw	10,102	1,236	0
E 4	Gas Driven Centrifugal	28,597	3,394	-6,578

2. Maintenance Cost Savings:

By installing a new chiller in place of the existing one, the installation will save the cost of retrofitting the machine for the HCFC-123 refrigerant as mentioned previously. The cost of this retrofit was estimated to be \$348,435 on page D-53. This value was used in the life cycle cost analysis as a non-recurring savings for each alternative.

E. Cost Estimates

The total installation costs for each alternative chiller mentioned in this ECO were estimated on pages D-54 through D-57. These costs were used in the life cycle cost analysis for each alternative. The results of the costs estimates were as follows:

Alternat	ive Chiller Type	Estimated Cost
E1	Electric Centrifugal	\$237,078
E2	Electric Centrifugal & VFD	\$277,051
E3	Electric Screw	\$240,791
E 4	Gas Driven Centrifugal	\$619,177

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on each chiller alternative for this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for each life cycle cost analysis is shown on pages D-58 through D-61. The results of the alternative life cycle cost analysis were as follows:

Alternative	Chiller Type	Payback Years	SIR
E 1	Electric Centrifugal	6.3	2.73
E2	Electric Centrifugal & VFD	7.1	2.42
E3	Electric Screw	6.8	2.56
E4	Gas Driven Centrifugal	12.4	1.24

Since the electric centrifugal chiller has the highest SIR, it is recommended as the most economical choice to replace the existing machine. The data from the life cycle cost analysis for this alternative were included in the summary on page D-44.

REFERENCES

- 1. Per current EPA regulations on CFC refrigerants.
- 2. See Appendix G for chiller retrofit estimates from Northeastern Research And Engineering Corporation.
- 3. See Appendix B for Area 2200 cooling system load profile.
- 4. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 5. See Appendix C for building field data and existing HVAC system data.
- 6. See Appendix G for manufacturer's equipment performance data from York International.
- 7. See Appendix A for utility cost analysis data, used in the savings calculations.

	JSE	ב									
	ANNUAL USE	-			_						
	ANNI	LWA	611,543	329,433	164,717	122,039					
	ES	WAS	56	26	26	26					
200	OPER. TIMES	DATO	7	2	7	7					
AREA 2	O	CYL	24	24	24	24					
STON,	-1 9	اد	322 KW	74.60 KW	37.30 KW	29.84 KW					
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-E1, FORT SAM HOUSTON, AREA 2200	FULL		32.	74.60	37.30	29.87					
ORT S	YEAR	LLED	New	1973	1973	1973					
O-E1, F	YE	INSTALLED	ž	19	19	19					
OR: ECO-F	VED										
LIST FO	AREA SERVED		200	200	200	500					
MENT	AR		Area 2200	Area 2200	Area 2200	Area 2200					
C EQUIF	z		ugal,								
D HVA	DESCRIPTION		roin water cooled, centrifugal, 555 tons, R-134a	36 ft	3 ft	ell					
OPOSE	DESC		water cooled, cen 555 tons, R-134a	Paco 1526 gpm, 166 ft 100 HP	Paco 1971 gpm, 63 ft 50 HP	Built-up crossflow, 2 cell 2-20HP fans					
PR(\ \ \ \	water 555 to	Paco 1526 (100 H	Paco 1971 gi 50 HP	Built-up crossflov 2-20HP					
	ΩTY.		-	1	1	1				·	
			<u></u>	dwn	Pump	3r					
	ITEM		Water Chiller	/ater Pi	Water	Cooling Tower					
e.,	E		Water	Chilled Water Pump	Condenser Water Pump	Coolin					
ð				ភ	Con						, ,

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-E2, FORT SAM HOUSTON, AREA 2200	TIMES		322 KW 24 7 26 5	Paco 1 1526 gpm, 166 ft Area 2200 1973 74.60 KW 24 7 26 329,433 100 HP	Paco 1 1971 gpm, 63 ft Area 2200 1973 37.30 KW 24 7 26 164,717 50 HP	Built-up 1 crossflow, 2 cell Area 2200 1973 29.84 KW 24 7 26 121,861 2-20HP fans 2-20HP fans				
PROPOSED HVAC			York, electric, VFD water cooled, centrifuge 555 tons, R-134a	Paco 1526 gpm, 166 ft 100 HP	Paco 1971 gpm, 63 ft 50 HP	Built-up crossflow, 2 cell 2-20HP fans				
	7	,	-	1	-	1				
no.	ITEM		Water Chiller	Chilled Water Pump	Condenser Water Pump	Cooling Tower				

	ANNUAL USE	KWH MCF	631,571	329,433	164,717	122,031				
	ES	WKS	56	26	26	26				
200	OPER. TIMES	DAYS	7	7	7	7				
AREA 2	ОО	HRS	24	24	24	24				
AM HOUSTON,	FULL	LOAD	355 KW	74.60 KW	37.30 KW	29.84 KW				
O-E3, FORT S,	YEAR	INSTALLED	New	1973	1973	1973				
MENT LIST FOR: EC	מני מני אני א	AREA SERVED	Area 2200	Area 2200	Area 2200	Area 2200				
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-E3, FORT SAM HOUSTON, AREA 2200 JUNE 2, 1995		DESCRIPTION	York water cooled, dual screw 555 tons, R-134a	Paco 1526 gpm, 166 ft 100 HP	Paco 1971 gpm, 63 ft 50 HP	Built-up crossflow, 2 cell 2-20HP fans				
	3		1	1	1	-				
**************************************			Water Chiller	Chilled Water Pump	Condenser Water Pump	Cooling Tower				

	UAL	KWH MCF	6,578	329,433	164,717	121,172					
	S	WKS	26	26 3	26 1	26 1					
200	OPER. TIMES	DAYS	7	7	7	7			·		
AREA 2	OPI	HRS	24	24	24	24					
AM HOUSTON,	FULL	LOAD	3,663 MBH	74.60 KW	37.30 KW	29.84 KW					
D-E4, FORT S.	YEAR	INSTALLED	New	1973	1973	1973					
MENT LIST FOR: ECC JUNE 2, 19	ADEA SEDVED	ANEA SERVED	Area 2200	Area 2200	Area 2200	Area 2200					
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-E4, FORT SAM HOUSTON, AREA 2200 JUNE 2, 1995	DESCRIPTION	DESCRIPTION	York, gas fired water cooled, centrifugal 555 tons, R-134a	Paco 1526 gpm, 166 ft 100 HP	Paco 1971 gpm, 63 ft 50 HP	Built-up crossflow, 2 cell 2-20HP fans					
	7		1	1	-	-					
	MHLI		Water Chiller	Chilled Water Pump	Condenser Water Pump	Cooling Tower					

2200 AREA

ITEM				EXIST	ING CI				LANT				ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					481.0	522.3	568.8	596.6	535.0	368.3			994,146	
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			121,471	
Totals					622.7	664.0	710.5	738.3	676.7	510.0			1,609,767	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					4,670	6,640	7,105	7,383	6,767	3,825				

Total Demand

36,390 \$/yr

Total Energy

5,494 MMBTU/yr

(electric)

Total Energy

MMBTU/yr

(gas)

ITEM			ECO-	E1: NE	W ELE	CTRIC LY PEAK			AL CHI	LLER			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					306.9	311.1	319.4	322.0	314.8	240.0			611,543	
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			122,039	
Total (KW)					448.6	452.8	461.1	463.7	456.5	381.7			1,227,732	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					3,365	4.528	4.611	4,637	4.565	2.863				

Total Demand

24,568 \$/yr

Demand Savings

11,822 \$/yr

Energy Savings

1,304 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

(gas)

ITEM		ECO	-E2: N	EW EL	ECTRIC MONTH				IILLER	WITH	VFD		ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					297.8	304.5	317.9	322.0	310.5	216.8			554,847	
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			121,861	
Total (KW)					439.5	446.2	459.6	463.7	452.2	358.5			1,170,858	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50	Ì	
Cost (\$)					3,296	4,462	4,596	4,637	4,522	2,689]	

Total Demand

24,202 \$/yr

Demand Savings

12,188 \$/yr

Energy Savings

1,498 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

2200 AREA

ITEM			EC	CO-E3:		ELECT LY PEAK			CHILLE	R			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					338.4	343.0	352.2	355.0	347.1	264.5			631,571	
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			122,031	
Total (KW)					480.1	484.7	493.9	496.7	488.8	406.2			1,247,752	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					3,601	4,847	4,939	4,967	4,888	3,047				

Total Demand

26,288 \$/yr

Demand Savings

10,102 \$/yr

Energy Savings

1,236 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

(gas)

ITEM		ı	ECO-E	4: NEV	V GAS MONTH		E CEN		GAL C	HILLER			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller														6,578
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			121,172	
Total (KW)					141.7	141.7	141.7	141.7	141.7	141.7			615,322	6,578
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					1,063	1,417	1,417	1,417	1,417	1,063				

Total Demand

7,794 \$/yr

Demand Savings

28,597 \$/yr

Energy Savings

3,394 MMBTU/yr

(electric)

Energy Savings

-6,578 MMBTU/yr

ENGINEER'S ESTIMATE OF PROBABLE COST	ATE	OF	PRO	BABLE	SOD =	T		
LOCATION: APER 2200 BILL DING 2265 FORT SAM HOLISTON		PROJECT NO:	ST NO:)	03-0185.04		DATE:	6/16/95
		BY:	PIEPER, C.A.	.A.		5	CHECKED BY:	CAP
PROJECT DESCRIPTION: ECO-E - Upgrade Existing R-11 Chiller To Operate With R-123	To Ope	erate W	/th R-12	ญ				
	QUANTITY	TITY		LABOR		MAT	MATERIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Retrofit of existing R-11 chiller to use R-123		20	80.00	\$28.00	\$2,240	\$250,000	\$250,000	\$252,240
R-123 detection eystem	-	eg eg				\$5,000	\$5,000	\$5,000
Chiller 2-speed ventilation fan	-	å	16.00	\$25.00	\$400	\$1,185	\$1,185	\$1,585
Chiller ventilation louver	5	saft	4.00	\$28.00	\$1,120	\$27	\$270	\$1,390
Test & balance	+	20	4.00	\$50.00	\$200			\$200
				SUBTOTAL	\$3,960		\$256,455	\$260,415
HIITT-701 I ARS INC	<u> </u>	0	& P @ 20%	%	\$792		\$51,291	\$52,083
ENGINEERS / ARCHITECTS				SUBTOTAL	\$4,752		\$307,746	\$312,498
512 MAIN STREET, SUITE 1500	1		DESIGN @ 6%	%9				\$18,750
FORT WORTH, TEXAS 76102-3922				SUBTOTAL				\$331,248
(817) 335-3000 * FAX (817) 335-1025		S	SIOH @ 6.6%	%				\$17,187
				TOTAL				\$348,435

ENGINEER'S ESTIMATE OF PROBABLE COST	ATE	OF	PR(OBAB	LE CO	ST		
LOCATION:		PROJECT NO:	CT NO:		03-0185.04		DATE:	6/16/95
AREA 2200, BUILDING 2265, FORT SAM HOUSTON		BY:	PIEPER, C.A.	C.A.		Н	СНЕСКЕВ ВҮ:	KLK
PROJECT DESCRIPTION: ECO-E1, Replace Existing Central Chiller With New Centrifugal Chiller	Chiller	With No	ew Cen	trifugal Ch	iller			
	QUAN	QUANTITY		LABOR	24	MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove chiller	-	EA	09	\$24.64	\$1,478	\$500	\$500	\$1,978
Install New Chiller 655 ton water cooled centrifical R-134a	-	я	1200	\$24.64	\$29.568	\$130.425	\$130,425	\$159,993
	-							
Pipe Assembly And Valves	-	EA	63	\$24.64	\$1,552	\$4,900	\$4,900	\$6,452
RECONNECT:								
Controls	-	JOB	65	\$24.64	\$1,602	\$100	\$100	\$1,702
Electrical	-	JOB	33	\$24.64	\$813	\$200	\$200	\$1,013
Refrigerant Detection System And Ventilation	-	900	14	\$24.64	\$1,010	\$4,000	\$4,000	\$5,010
Test & Balance and Start-up	-	gor	30	\$28.00	\$840	\$200	\$200	\$1,040
				SUBTOTAL	\$36,863		\$140,325	\$177,188
ONI SAD I IOZ-TTIIIH		0	& P @	20%	\$7,373		\$28,065	\$35,438
ENCINEEDS / ADCHITECTS				SUBTOTAL	\$44,236		\$168,390	\$212,626
512 MAIN STREET, SUITE 1500		D	DESIGN @ 6%	%9 i				\$12,758
FORT WORTH, TEXAS 76102-3922				SUBTOTAL				\$225,384
(817) 335-3000 * FAX (817) 335-1025		S	SIOH @ 6.6%	%9				\$11,694
				TOTAL				\$237,078

ENGINEER'S ESTIMATE OF PROBABLE COST	ATE	Ö	PRC	BABI	E CO	ST		
LOCATION:		PROJE	PROJECT NO:)	03-0185.04		DATE:	6/16/95
AREA 2200, BUILDING 2265, FORT SAM HOUSTON		BY:	PIEPER, C.A.	٧.		CH	CHECKED BY:	KLK
PROJECT DESCRIPTION: ECO-E2, Replace Existing Central Chiller With New Centrifugal Chiller And Variable Frequency Drive (VFD)	Chiller	· With !	Vew Cent	rifugal Chi	ller And Va	ariable Frequer	1cy Drive (VF	۵)
	QUANTITY	TITY		LABOR		MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Totai	COST
Remove chiller	-	EA	00.09	\$24.64	\$1,478	\$500.00	\$500	\$1,978
	-	Ц Д	00000	\$04.64	800 DOR	\$180 425 OO	\$120.425	\$159 993
Install New Chiller DOD COT, water cooled cellul lugal N 10-1a	-	3	200	5:53	200,000			
Adder For VFD	-	2				\$29,875.00	\$29,875	\$29,875
Pipe Assembly And Valves	-	EA	63.00	\$24.64	\$1,552	\$4,900.00	\$4,900	\$6,452
RECONNECT:								
Controls	-	JOB	00.59	\$24.64	\$1,602	\$100.00	\$100	\$1,702
Electrical	-	900	33.00	\$24.64	\$813	\$200.00	\$200	\$1,013
Refrigerant Detection System And Ventilation	-	gor	41.00	\$24.64	\$1,010	\$4,000.00	\$4,000	\$5,010
Test & Balance and Start-up	-	JOB	30.00	\$28.00	\$840	\$200.00	\$200	\$1,040
	Γ			SUBTOTAL	\$36,863		\$170,200	\$207,063
HIITT-701 ARS INC			O&P@20%	%	\$7,373		\$34,040	\$41,413
ENCINEEDS / ADCUITECTS				SUBTOTAL	\$44,236		\$204,240	\$248,476
512 MAIN STREET SLITE 1500			DESIGN @ 6%	%9				\$14,909
FORT WORTH, TEXAS 76102-3922				SUBTOTAL				\$263,385
(817) 335-3000 * FAX (817) 335-1025			SIOH @ 6.6%	%				\$13,666
	ı			TOTAL				\$277,051

ENGINEER'S ESTIMATE OF PROBABLE COST	ATE	PP	PRO	BAB	LE CO	ST		
LOCATION:	Ī	PROJECT NO:	:ON T		03-0185.04		DATE:	6/16/95
AREA 2200, BUILDING 2265, FORT SAM HOUSTON	1	BY:	PIEPER, C.A.	C.A.		СН	снескер ву:	KLK
PROJECT DESCRIPTION: ECO-E3, Replace Existing Central Chiller With Water Cooled, Dual Screw Chiller	Chiller	With Wa	iter Coo	oled, Dual	Screw Chille	i.		
	QUANTITY	TITY		LABOR		MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove chiller	-	EA	00	\$24.64	\$1,478	005\$	\$500	\$1,978
		1		10000	000	000 22.4	000 2214	4100769
Install New Chiller 555 ton, water cooled, dual screw, R-134a	-	EA	1,200	\$24.04	900,62\$	002,661\$	002,001\$	907,201¢
Pipe Assembly And Valves	-	EA	63	\$24.64	\$1,552	\$4,900	\$4,900	\$6,452
RECONNECT:								
Controls	-	JOB	92	\$24.64	\$1,602	\$100	\$100	\$1,702
Electrical	-	JOB	33	\$24.64	\$813	\$200	\$200	\$1,013
		9	;	10101	200	4	4	040
Refrigerant Detection System And Ventilation	-	305	4	\$24.04	00,19	000,44	500,4	010,04
Test & Balance and Start-up	-	gor	30	\$28.00	\$840	\$200	\$200	\$1,040
				SUBTOTAL	\$36,863		\$143,100	\$179,963
UI JABO INC	1		0 & P @ 2	20%	\$7,373		\$28,620	\$35,993
				SUBTOTAL	\$44,236		\$171,720	\$215,956
ENGINEERS / ARCHIECLS	1	٥	DESIGN @ 6%	%9				\$12,957
FORT WORTH, TEXAS 76102-3922	!			SUBTOTAL				\$228,913
(817) 335-3000 * FAX (817) 335-1025		S	SIOH @ 5.5%	2%				\$11,878
	1			TOTAL				\$240,791

ENGINEER'S ESTIN	IAT	EOF	PRO	BABL	ESTIMATE OF PROBABLE COST	TS		
LOCATION:		PROJECT NO:	T NO:		03-0185.04		DATE:	6/16/95
AREA 2200, BUILDING 2265, FORT SAM HOUSTON		BY:	PIEPER, C.A.	ď		CH	снескер ву:	KLK
PROJECT DESCRIPTION: ECO-E4, Replace Existing Central	Chiller	With Ga	ıs Engine	g Central Chiller With Gas Engine Driven Chiller	ller			
	QUA	QUANTITY		LABOR		MATERIAL	SIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove chiller	-	EA	00.00	\$24.64	\$1,478	\$500	\$500	\$1,978
		i	0		0000	000 000	416,000	# 4 4 5 5 6 B
Install New Chiller 555 ton, water cooled centrifugal, R-134a, gas fired	-	EA	1200.00	\$24.64	20C'67\$	000,014	44.00°C	00000
Pine Accomply And Valvea	-	E	63.00	\$24.64	\$1,552	\$4,900	\$4,900	\$6,452
The Abbelling This raise								
RECONNECT:								
Controls	-	JOB	00.39	\$24.64	\$1,602	\$100	\$100	\$1,702
Electrical	-	JOB	33.00	\$24.64	\$813	\$200	\$200	\$1,013
Refrigerant Detection System And Ventilation	-	JOB	41.00	\$24.64	\$1,010	\$4,000	\$4,000	\$5,010
Test & Balance and Gtart-110	-	gor	30.00	\$28.00	\$840	\$200	\$200	\$1,040
				SUBTOTAL	\$36,863		\$425,900	\$462,763
ONI SAVI IOZ-TTIIIH			O&P@20%	*	\$7,373		\$85,180	\$92,553
STOCK ADDITION				SUBTOTAL	\$44,236		\$511,080	\$555,316
ENGINEERS / ARCHIECTS			DESIGN @ 6%	%8				\$33,319
FORT WORTH, TEXAS 76102-3922				SUBTOTAL				\$588,635
(817) 335-3000 * FAX (817) 335-1025			SIOH @ 6.5%	%				\$30,542
				TOTAL				\$619,177

STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) REGION NOS. 6 CENSUS: 3 INSTALLATION & LOCATION: FSH PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E1 ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 212626. B. SIOH 11694. C. DESIGN COST 12758. D. TOTAL COST (1A+1B+1C) \$ 237078. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ 0. F. PUBLIC UTILITY COMPANY REBATE \$ 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 237078. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS(5) 1304. \$ 8189. 0. \$ 0. 0. \$ 0. 0. \$ 0. 0. \$ 0. 0. \$ 0. \$ 11822. 6.28 A. ELECT \$ 15.08 123492. B. DIST \$.00 18.57 0. C. RESID \$.00 21.02 0. \$ 0. \$ 0. \$ 0. \$ 11822. D. NAT G \$ 2.66 18.58 0. E. COAL \$.00 16.83 0. F. PPG \$.00 17.38 0. \$ 175911. M. DEMAND SAVINGS 14.88 1304. \$ 20011. N. TOTAL 299403. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) DISCNT DISCOUNTED FACTR SAVINGS(+)/ SAVINGS(+) YR ITEM COST(-) OC (2) (1) (3) COST(-)(4)1. REFRIG UPGRADE \$ 348435. 1.00 0 348435. d. TOTAL \$ 348435. 348435. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 348435. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 37433. 5. SIMPLE PAYBACK PERIOD (1G/4) 6.33 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 647838. 7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.73 (IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E2 ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 248476. B. SIOH 13666. C. DESIGN COST 14909. D. TOTAL COST (1A+1B+1C) \$ 277051. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE \$ 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 277051. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS (5) 1498. \$ 0. \$ 9407. A. ELECT \$ 6.28 15.08 141864. .00 B. DIST \$ 0. 18.57 0. 0. \$ 0. \$ 0. \$ 0. \$ 1498. \$ C. RESID \$.00 0. 21.02 0. 0. D. NAT G \$ 2.66 18.58 0. 0. E. COAL \$.00 16.83 0. F. PPG \$.00 0. 17.38 0. 12188. M. DEMAND SAVINGS 14.88 181357. N. TOTAL 21595. 323222. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) DISCOUNTED SAVINGS(+)/ SAVINGS(+) YR DISCNT COST(-) ITEM OC FACTR (1) \$ 348435. COST(-)(4)(2) (3) 1. REFRIG UPGRADE 0 1.00 348435. d. TOTAL \$ 348435. 348435. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 348435. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 39017. 5. SIMPLE PAYBACK PERIOD (1G/4) 7.10 YEAF 671657. 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =2.42 (IF < 1 PROJECT DOES NOT QUALIFY)

D-59

LCCID FY95 (92) ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E3 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER ANALYSIS DATE: 1. INVESTMENT A. CONSTRUCTION COST 215956. B. SIOH 11878. C. DESIGN COST 12957. D. TOTAL COST (1A+1B+1C) \$ 240791. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 240791. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS (5) 1236. \$ A. ELECT S 6.28 7762. 15.08 117052. .00 B. DIST \$ 0. 0. 0. 18.57 0. 0. 0. C. RESID \$.00 \$ 0. 21.02 0. D. NAT G \$ 2.66 0. 18.58 0. \$ 0. \$ 0. \$ 10102. E. COAL \$.00 16.83 0. F. PPG \$.00 17.38 0. M. DEMAND SAVINGS 14.88 150318. 1236. \$ N. TOTAL 17864. 267370. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED COST(-) ITEM OC FACTR SAVINGS(+)/ (1) (2) (3) COST(-)(4)1. REFRIG UPGRADE 0 \$ 348435. 1.00 348435. d. TOTAL \$ 348435. 348435. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 348435. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 35286. 5. SIMPLE PAYBACK PERIOD (1G/4) 6.82 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 615805. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =2.56 (IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FSH

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E4 ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 555316. B. SIOH 30542. C. DESIGN COST 33319. D. TOTAL COST (1A+1B+1C) \$ 619177. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 619177. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS (5) 3394. A. ELECT \$ 6.28 21314. 15.08 321420. B. DIST \$.00 0. 0. 18.57 0. C. RESID \$.00 0. \$ -17497. \$ 21.02 0. -6578. D. NAT G S 2.66 18.58 -325103. 0. E. COAL \$.00 16.83 0. F. PPG S .00 0. 17.38 0. \$ 28597. M. DEMAND SAVINGS 425523. 14.88 -3184. N. TOTAL 32414. 421840. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED ITEM COST(-) oc FACTR SAVINGS(+)/ (2) (3) (1) COST(-)(4)1. REFRIG UPGRADE \$ 348435. 0 1.00 348435. d. TOTAL \$ 348435. 348435. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 348435. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 49836. 5. SIMPLE PAYBACK PERIOD (1G/4) 12.42 YEAR: 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 770275. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =(IF < 1 PROJECT DOES NOT QUALIFY)

** Project does not qualify for ECIP funding; 4,5,6 for information only.

D-61

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:

DATE: 6/15/95

ECO TITLE: Replace Existing Individual Building Chillers With Central Chiller Plant

INSTALLATION: Fort Sam Houston, San Antonio, Texas

LOCATION: Area 100, Building 250

A. Summary:

Electrical Energy Savings	2,816	MMBTU/yr
Electrical Demand Savings	19,781	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	2,816	MMBTU/yr
Total Cost Savings	64,465	\$/yr
Total Investment	556,559	\$
Simple Payback	8.6	yrs
SIR	1.73	

B. ECO Description:

Remove the 14 existing air cooled, reciprocating chillers serving buildings 122, 124, 125, 128, 133, 134, 135, 142, 143, 144, 146, 147, 149, 197, 198, 199 and 250. Install 6" chilled water supply and return piping loop between the buildings in this area and terminate loop behind building 250, near the existing air cooled chiller installation. Install two new 210 ton, air cooled screw chillers behind building 250. Install two new 30 HP chilled water distribution pumps to circulate water from new chillers through new distribution loop. The existing chilled water pumps that serve buildings where chillers were removed will be reused to circulate chilled water from the new loop through the buildings. These existing pumps should be connected into the new distribution piping at the existing chiller locations. All new controls and electrical services should be installed at building 250 to serve the new chillers and pumps. Other specific requirements should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

C. Discussion:

The 14 existing air cooled, reciprocating chillers in the 100 area were installed in 1985 and serves as the primary cooling systems for 17 buildings. They generally appear to be in fair condition at this time. However, the cost of maintaining so many chillers is excessive and difficult for the maintenance staff. It is recommended that a central chiller plant, consisting of two air cooled screw machines be installed to serve all these buildings. This will not only save energy but will also greatly reduce the maintenance costs to the installation. Computer simulations of the buildings in this area determined that the current installed capacity of 540 tons is more than is required to adequately cool the buildings¹. Therefore, it is recommended that the two new chillers be rated at a combined 420 tons to more closely match the cooling load of the buildings.

D. Savings Calculations:

1. Energy Consumption And Savings

The monthly peak demand and energy consumptions of the existing and proposed chillers and pumps were calculated using the Trace 600 computer program². The buildings served by the existing chillers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models³.

The 210 ton air cooled screw chillers which were modeled by the computer had better part load performance ratings than reciprocating machines and were chosen for that reason. Full and part load performance data from McQuay Incorporated were used in the computer simulations of the new chiller energy usages. An equipment list of the specific chillers and pumps modeled for the new central plant are shown on page D-64.

Once the computer simulations of the existing and new chiller plants were completed, the total annual demand cost and energy consumption of the new central plant was compared with that of the existing individual systems to determine the annual savings for this ECO⁴. These savings calculations are shown on pages D-65 and D-66. These demand and energy savings values were used in the life cycle cost analysis.

2. Maintenance Cost Savings:

Maintenance cost estimates were obtained from a local maintenance contractor and were used to estimate the maintenance savings from reducing the total number of air cooled chillers in this area from fourteen down to two⁵. Based on an annual maintenance cost of \$2,250 per chiller, the total maintenance cost savings from this ECO is estimated to be \$27,000 per year. This figure was used in the life cycle cost analysis.

E. Cost Estimates

The total installation costs for the new central chiller plant were estimated on page D-67. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page D-68. The data from the summary sheet were presented in the ECO summary on page D-62.

REFERENCES

- 1. See Appendix B for Area 100 cooling system load profile.
- 2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 3. See Appendix C for building field data and existing HVAC system data.
- 4. See Appendix A for utility cost analysis data, used in the savings calculations.
- 5. See Appendix G for maintenance contractor cost estimates for air cooled chillers.

	UAL	KWH MCF	508,916	220,753	98,830	33,570				
	ES	WKS	26	26	26	26				
00	OPER. TIMES	DAYS	7	7	7	7				
AREA 10	ОР	HRS	24	24	24	24				
AM HOUSTON,	FULL	LOAD	240 KW	240 KW	22.38 KW	22.38 KW				
30-1, FORT SA	YEAR	INSTALLED	New	New	New	New				
PMENT LIST FOR: E	מה ימה אים א	AREA SERVED	Area 100	Area 100	Area 100	Area 100				
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-1, FORT SAM HOUSTON, AREA 100 JUNE 2, 1995		DESCRIPTION	McQuay, electric air cooled, single screw 210 Tons, R-134a	McQuay, electric air cooled, single screw 210 Tons, R-134a	504 gpm, 150 ft 30 HP	504 gpm, 150 ft 30 HP				
	7	<u>2</u>	-	1	1	-				
	1111	IEM	Water Chiller	Water Chiller	Chilled Water Pump	Chilled Water Pump				

ITEM			E		NG IND				LANTS				ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					47.5	53.0	56.9	56.3	47.8	35.0			92,395	
Water Chiller					58.3	64.4	69.1	68.0	57.9	42.2			112,912	
Water Chiller					28.4	29.7	30.8	30.6	28.6	26.3			12,045	
Water Chiller					37.5	42.4	44.8	44.4	38.6	27.0			76,773	
Water Chiller					49.6	51.8	53.8	53.3	49.8	45.5			104,024	
Water Chiller					61.4	66.6	71.5	72.2	62.9	49.7			113,775	
Water Chiller					61.4	66.6	71.5	72.2	62.9	49.7			113,775	
Water Chiller					59.0	64.1	68.9	69.7	60.6	47.5			107,387	
Water Chiller					70.0	76.4	85.0	83.4	74.2	56.3			170,355	
Water Chiller					60.4	65.5	70.3	70.6	61.9	49.6			113,383	
Water Chiller					16.1	17.3	17.9	17.8	16.6	12.9			30,616	
Water Chiller					21.6	23.9	26.2	26.6	22.6	16.0			43,319	
Water Chiller					117.2	122.9	133.5	137.3	118.3	87.7			346,860	
Water Chiller					13.8	15.3	16.5	16.7	14.0	9.8			26,626	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					1.1	1.1	1.1	1.1	1.1	1.1			4,946	
CHW Pump					1.1	1.1	1.1	1.1	1.1	1.1			4,946	
CHW Pump					0.4	0.4	0.4	0.4	0.4	0.4			1,634	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					1.1	1.1	1.1	1.1	1.1	1.1			4,946	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			16,472	
CHW Pump					1.5	1.5	1.5	1.5	1.5	1.5			6,580	
CHW Pump					1.1	1.1	1.1	1.1	1.1	1.1			4,946	
CHW Pump					1.5	1.5	1.5	1.5	1.5	1.5			6,580	
CHW Pump					5.6	5.6	5.6	5.6	5.6	5.6			24,730	
CHW Pump					0.8	0.8	0.8	0.8	0.8	0.8			3,312	
Air Cooled Comp.					8.0	8.3	8.6	8.6	8.0	7.4			12,232	
Compresser Fans					0.6	0.7	0.7	0.7	0.6				1,008	
Air Cooled Comp.					63.6	66.4	68.8	68.3	63.8	58.9			64,825	
Compresser Fans					4.5	4.8	6.2		4.6	3.6			6,524	
Totals					810.0	871.2	932.1	934.0	824.8	656.6			1,687,278	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00			7.50	7.50	1	
Cost (\$)					6,075		9,321	9,340		4,925				

Total Demand

46,621 \$/yr

Total Energy

5,759 MMBTU/yr

(electric)

Total Energy

MMBTU/yr

100 AREA

ITEM		E	CO-I: N	NEW C	ENTRA MONTH				REW CH	HILLER	s		ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					210.8	234.2	240.0	240.0	221.0	187.4			508,916	
Water Chiller					210.8	234.2	240.0	240.0	221.0	147.2			220,753	
CHW Pump					22.4	22.4	22.4	22.4	22.4	22.4			98,830	
CHW Pump					22.4	22.4	22.4	22.4	22.4	22.4			33,570	
Total (KW)					466.4	513.2	524.8	524.8	486.8	379.4			862,069	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					3,498	5,132	5,248	5,248	4,868	2,846				

Total Demand

26,840 \$/yr

Demand Savings

19,781 \$/yr

Energy Savings

2,816 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

PIEPER, C.A ers With Cen unit Unit Unit 120 \$ \$ 192 \$ \$ 120 \$	Replace Existing	BY: BY: BY: Unit Meas. EA EA EA EA EA EA EA	CT NO: PIEPER, C With C With C 650 650 660 660	5.7A. LABOR LABOR \$24.64 \$24.64 \$24.64	03-0185.04 Total	MA.	DATE: CHECKED BY:	6/16/95 KLK
PTION: ECO-1, Replace Existing ITEM DESCRIPTION er Pump 30 HP te Distribution ves Chiller Assembly G" Trench & backfill	Replace Existing	BY: Ig Chiller Unit Meas. EA EA EA EA EA EA EA EA EA E	PIEPER, (Hrs / Unit 20 20 20 60 60	5.A. LABOR Rate \$24.64 \$23.64 \$24.64	### Total Total \$13,798 \$30,732		ECKED BY:	KLK
PTION: ECO-1, Replace Existing ITEM DESCRIPTION er Pump 30 HP te Distribution ves Chiller Assembly G" Trench & backfill	Replace Existing	NTITY Notification Chiller EA	9 With C 650 650 60 60 60 60 60 60 60 60 60 60 60 60 60	#24.64 \$24.64 \$24.64 \$24.64	## Total Total \$13,798 \$30,732	MATE Unit Price		
TEM DESCRIPTION	TION Screw R-22 2	Unit Meas. Unit EA	Hrs / Unit 40 650 650 60 60 60 60 60 60 60 60 60 60 60 60 60	1ABOR 824.64 \$23.64 \$24.64	\$13,798 \$30,732 \$986	MATE		
ten DESCRIPTION # of Unit Unit Hrs / Uni	TION screw R-22		Hrs / Unit C50 650 60 60 60 60 60 60 60 60 60 60 60 60 60	824.64 \$24.64 \$24.64	\$13,798 \$30,732 \$986	Unit Price	RIAL	10.0
ton, air-cooled, single screw R-22 er Pump 30 HP te Distribution te Dis	ecrew R-22		65 65 66 66 66 66 66 66 66 66 66 66 66 6	\$24.64 \$23.64 \$24.64 \$24.64	\$13,798 \$30,732 \$986		Total	COST
ton, air-cooled, single screw R-22 er Pump 30 HP te Distribution te Distribution wes Chiller Assembly G" Trench & backfill 1 JOB 390 1 JOB 120	ocrew R-22		0 0 0 0 0 0	\$24.64	\$13,798 \$30,732 \$986			
ton, air-cooled, single screw R-22	ocrew R-22		60 20 60	\$23.64 \$24.64 \$24.64	\$30,732	\$200	\$7,000	\$20,798
er Pump 30 HP 2 EA 20 te Distribution 16 EA 6 ves Chiller Assembly 2 EA 60 . G" Trench & backfill 2950 LF 1 . G" Trench & backfill 1 JOB 390 1 JOB 192 1 JOB 120 1 JOB 120			0 0	\$24.64	986\$	\$73,500	\$147,000	\$177,732
er Pump 30 HP 2 EA 20 te Distribution 16 EA 6 ves Chiller Assembly 2 EA 60 ves Chiller Assembly 2 EA 60 o" Trench & backfill 1 JOB 390 1 JOB 192 1 JOB 120 1 JOB 120 1 JOB 120			00 00	\$24.64	\$986			
te Distribution 16 EA 6 ves Chiller Assembly 2 EA 60 . 6" Trench & backfill 2950 LF 1 1 JOB 390 1 JOB 192 1 JOB 120 1 JOB 120			0 00	\$24.64		\$3,957	\$7,914	\$8,900
te Distribution 16 EA 6 ves Chiller Assembly 2 EA 60 . 6" Trench & backfill 2950 LF 1 1 JOB 390 1 JOB 192 1 JOB 120 1 JOB 120			0 0	\$24.64				
ves Chiller Assembly 2 EA 60 . 6" Trench & backfill 2950 LF 1 1 JOB 390 192 1 JOB 192 192 1 JOB 120 120			00		\$2,365	\$800	\$12,800	\$15,165
6" Trench & backfill 2950 LF 1 1 JOB 390 1 JOB 192 1 JOB 120				\$24.64	\$2,957	\$3,300	\$6,600	\$9,557
1 JOB 390 1 JOB 192 1 JOB 120			-	\$24.64	\$72,688	\$17	\$50,150	\$122,838
1 JOB 390 1 JOB 192 1 JOB 120								
1 JOB 192 192 120 1 1 JOB 120	-	JOB	290	\$24.64	\$9,610	\$26,000	\$26,000	\$35,610
1 308 120		JOB	192	\$24.64	\$4,731	\$13,800	\$13,800	\$18,531
1 308 120	•							
	-	JOB	120	\$15.60	\$1,872	\$1,400	\$1,400	\$3,272
120		JOB	120	\$28.00	\$3,360	\$200	\$200	\$3,560
			S	SUBTOTAL	\$143,099		\$272,864	\$415,963
HUITT-ZOLLARS. INC.	SS. INC.)	& P	%	\$28,620		\$54,573	\$83,193
	HITECTS		S	SUBTOTAL	\$171,719		\$327,437	\$499,156
512 MAIN STREET, SUITE 1500	UITE 1500	0	ESIGN @	%:				\$29,949
FORT WORTH, TEXAS 76102-3922	76102-3922		S	SUBTOTAL				\$529,105
%9'9 WOIS		0,	ЮН @ 5.5%	*				\$27,454
TOTA				TOTAL				\$556,559

```
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
                                                    LCCID FY95 (92)
INSTALLATION & LOCATION: FSH
                                     REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504
                                 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-I
ANALYSIS DATE:
               06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER
1. INVESTMENT
A. CONSTRUCTION COST
                             499156.
B. STOH
                         $
                              27454.
C. DESIGN COST
                         Ŝ
                             29949.
D. TOTAL COST (1A+1B+1C) $ 556559.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $
F. PUBLIC UTILITY COMPANY REBATE
                                            0.
G. TOTAL INVESTMENT (1D - 1E - 1F)
                                                      556559.
2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994
            UNIT COST SAVINGS ANNUAL $ DISCOUNT
                                                           DISCOUNTED
            $/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4)
   FUEL
                                                           SAVINGS (5)
   A. ELECT $
               6.28
                          2816.
                                        17684.
                                                    15.08
                                                               266682.
   B. DIST
               .00
                          0.
                                        0.
                                                   18.57
                                                                   0.
                         0.
0.
0.
   C. RESID $
                .00
                                    $
                                                                    0.
                                           0.
                                                   21.02
   D. NAT G $
               2.66
                                           0.
                                                   18.58
                                                                    0.
   E. COAL $
               .00
                                           0.
                                                   16.83
                                                                    0.
   F. PPG
           $ .00
                                           0.
                                                   17.38
                                                                    0.
                                      0.
19781.
                         $
2816. $
   M. DEMAND SAVINGS
                                                    14.88
                                                               294341.
   N. TOTAL
                                        37465.
                                                               561023.
3. NON ENERGY SAVINGS(+) / COST(-)
  A. ANNUAL RECURRING (+/-)
                                                                27000.
       (1) DISCOUNT FACTOR (TABLE A)
                                                   14.88
       (2) DISCOUNTED SAVING/COST (3A X 3A1)
                                                               401760.
  B. NON RECURRING SAVINGS(+) / COSTS(-)
                           SAVINGS(+) YR
                                            DISCNT
                                                      DISCOUNTED
                             COST(-)
              ITEM
                                       OC
                                                      SAVINGS(+)/
                                            FACTR
                                                     COST(-)(4)
                                (1)
                                      (2)
                                             (3)
   d. TOTAL
                                 0.
                                                             0.
  C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 401760.
4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$
                                                               64465.
5. SIMPLE PAYBACK PERIOD (1G/4)
                                                              8.63 YEAR
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)
                                                               962783.
7. SAVINGS TO INVESTMENT RATIO
                                    (SIR) = (6 / 1G) =
                                                              1.73
    (IF < 1 PROJECT DOES NOT QUALIFY)
```

LIFE CYCLE COST ANALYSIS SUMMARY

D-68

STUDY: FSH

APPENDIX E NON-RECOMMENDED ECO CALCULATIONS

APPENDIX E NON-RECOMMENDED ECO CALCULATIONS

TABLE OF CONTENTS

ECO-B, R	Replace Existing Central Boilers With High Efficiency Modular Boilers, Area 900	E-1
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ECO-J, Re	Leplace Existing Individual Building Boilers With Central Boiler Plant, Area 100	E-25

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:

В

DATE:

6/15/95

ECO TITLE:

Replace Existing Central Boilers With High Efficiency Modular Boiler

INSTALLATION:

Fort Sam Houston, San Antonio, Texas

LOCATION:

Area 900, Building 902

A. Summary:

Electrical Energy Savings	0	MMBTU/yr
Electrical Demand Savings	0	\$/yr
Gas Energy Savings	1,235	MMBTU/yr
Total Energy Savings	1,235	MMBTU/yr
Total Cost Savings	3,285	\$/yr
Total Investment	50,591	\$
Simple Payback	15.4	yrs
SIR	1.21	

B. ECO Description:

Remove the three existing watertube boilers in building 902 which are serving the 21 buildings in the 900 area. Install one new modular high efficiency boiler, rated at 1,830 MBH output in place of the existing boilers. Connect the new boiler to the existing distribution headers at the existing boiler location. The four existing heating water distribution pumps in building 902 should be reused. The existing electrical service and controls should be reused as much as possible. Other specific requirements in these areas should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing boilers, and installation of the new boilers, associated wiring and controls.

C. Discussion:

The three existing watertube boilers serving the 900 area buildings were installed in 1985 and are rated at 1,665 MBH output capacity each. The four existing pumps in 902 circulate HW from these boilers through the buildings. All these boilers and pumps appear to be in fair condition. Computer simulations of the 21 buildings served by these boilers determined that the current combined capacity of 4,995 MBH is about 2 ½ times the amount required to adequately heat the buildings¹. The existing boilers are therefore operating at an inefficient, low load condition most of the time. The new high efficiency modular boiler is designed to maintain extremely high efficiencies even at very low load conditions and is therefore recommended to replace the existing boilers. The decrease in the boiler output capacity to 1,830 MBH is recommended to more closely match the heating load in the buildings.

D. Savings Calculations:

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pumps were calculated using the Trace 600 computer program². The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models³.

The new high efficiency, modular type boiler modeled was rated at 1,830 MBH output. Full and part load performance data from Aerco International were used in the computer simulations of the new boiler energy usage⁴. An equipment list with specific data on the new boiler and existing pumps used in the

computer simulation is shown on page E-3.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings⁵. These savings calculations are shown on page E-4. The demand and energy savings values were used in the life cycle cost analysis for this ECO.

E. Cost Estimates

The total installation costs for this ECO were estimated on page E-5. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-6. The data from the life cycle cost analysis were included in the summary on page E-1.

REFERENCES

- 1. See Appendix B for Area 900 heating system load profile.
- 2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 3. See Appendix C for building field data and existing HVAC system data.
- 4. See Appendix G for manufacturer's equipment performance data from Aerco International.
- 5. See Appendix A for utility cost analysis data, used in the savings calculations.

	UAL I	KWH MCF	6,574	32,675	32,675	13,052	9,811				
	ES	WKS	56	56	56	56	26				
00	OPER. TIMES	DAYS	7	7	7	7	7				
AREA 9	Q	HRS	24	24	24	24	24				
AM HOUSTON,	FULL	LOAD	2,000 MBH	3.73 KW	3.73 KW	1.49 KW	1.12 KW				
:0-B, FORT S/ 35	YEAR	INSTALLED	New	Exist	Exist	Exist	Exist				
PMENT LIST FOR: EC		AREA SERVED	Area 900	Area 900	Area 900	Area 900	Bldg. 902				
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-B, FORT SAM HOUSTON, AREA 900 JUNE 2, 1995		DESCRIPTION	Aerco #KC-2000 GWB natural draft, watertube 1,758 MBH output	Weinman 200 gpm, 38 ft 5 HP	Weinman 115 gpm, 30 ft 5 HP	Weinman 115 gpm, 30 ft 2 HP	Peerless 1.5 HP				
		Ω	-	-	-	-	~				
		ITEM	Hot Water Boiler	Heating Water Pump	Heating Water Pump	Heating Water Pump	Heating Water Pump				

900 AREA

ITEM				EXIS.		ENTR/		LER PL ID (KW)	ANT				ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	((\(\nu\)	(MCF)
Watertube Boiler														7,809
HW Pump	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	32,675	
HW Pump	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	32,675	
HW Pump	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	13,052	
HW Pump	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	9,811	
Totals	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	88,213	7,809
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	75	75	75	75	75	100	100	100	100	75	75	75		

Total Demand

1,000 \$/yr

Total Energy

301 MMBTU/yr

(electric)

Total Energy

7,809 MMBTU/yr

(gas)

ITEM			ECO-E	3: NEV	V CENT	FRAL H			NCY BO	OILER			ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Modular Boiler														6,574
HW Pump	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	32,675	
HW Pump	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	32,675	
HW Pump	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	13,052	
HW Pump	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	9,811	
Total (KW)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	88,213	6,574
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	75	75	75	75	75	100	100	100	100	75	75	75	1	

Total Demand

1,000 \$/yr

Demand Savings

\$/yr

Energy Savings

MMBTU/yr

(electric)

Energy Savings

1,235 MMBTU/yr

ENGINEER'S ESTIMATE	MATE		PRC	BABI	OF PROBABLE COST	ST		
LOCATION:		PROJECT NO:	ST NO:		03-0185.04		DATE:	6/16/95
AKEA 900, BUIDING 902, FORT SAM HOUSTON		BY:	PIEPER, C.A.	S.A.		НЭ	снескер ву:	KLK
PROJECT DESCRIPTION: ECO-B, Replace Existing Central Boilers With New High Efficiency Modular Boiler	Boilers \	With Ne	w High E	fficiency h	dodular Bo	iler		
	QUAI	QUANTITY		LABOR		MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Totai	COST
Remove Boilers	Ю	EA	09	\$24.64	\$4,435	\$500	\$1,500	\$5,935
Man Bailer AEPCO # KC 2000 GWB Water Tibe 1758 MBH	-	FA	80	\$24.64	\$1.971	\$18,000	\$18,000	\$19,971
pipe Assembly & valves	-	JOB	28	\$24.64	069\$	\$2,400	\$2,400	\$3,090
Boiler Breachina Stainless steel	5	7	2	\$24.64	\$1,971	\$147	\$5,880	\$7,851
Reconnect Controls	-	JOB	10	\$24.64	\$246	\$55	\$55	\$301
Reconnect Electrical	-	JOB	0	\$26.64	\$160	\$64	\$64	\$224
Reconnect Chemical system	-	JOB	2	\$26.64	\$133	\$50	\$50	\$183
Test, Balance & Start-up	-	SI	5	\$25.64	\$256			\$256
				SUBTOTAL	\$9,862		\$27,949	\$37,811
ONI SOVI ICE THIS			0 & P @ 2	20%	\$1,972		\$5,590	\$7,562
TOTI TOTI TOTI TOTI				SUBTOTAL	\$11,834		\$33,539	\$45,373
612 MAIN STREET SLITE 1500		ַ	DESIGN @ 6%	%9				\$2,722
FORT WORTH, TEXAS 76102-3922				SUBTOTAL				\$48,095
(817) 335-3000 * FAX (817) 335-1025			SIOH @ 5.	5.5%				\$2,496
	1			TOTAL				\$50,591

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) REGION NOS. 6 CENSUS: 3 INSTALLATION & LOCATION: FSH PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-B 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER ANALYSIS DATE: 1. INVESTMENT A. CONSTRUCTION COST 45373. B. SIOH 2496. C. DESIGN COST 2722. D. TOTAL COST (1A+1B+1C) \$ E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE G. TOTAL INVESTMENT (1D - 1E - 1F) 50591. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS(5) 6.28 A. ELECT S 0. Ο. 15.08 0. .00 B. DIST \$ 0. 0. 18.57 0. C. RESID \$.00 0. 0. 21.02 0. \$ 3285. \$ 0. D. NAT G \$ 2.66 1235. 18.58 61037. .00 0. 0. E. COAL \$ 16.83 0. F. PPG \$.00 0. 17.38 0. 0. M. DEMAND SAVINGS 0. 14.88 0. N. TOTAL 1235. 61037. 3285. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) \$ 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 Ś (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED COST(-) ITEM OC FACTR SAVINGS(+)/ (1) COST(-)(4)(2) (3) 0. d. TOTAL 0. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 3285. 15.40 YEARS 5. SIMPLE PAYBACK PERIOD (1G/4) 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 61037. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =1.21

LIFE CYCLE COST ANALYSIS SUMMARY

(IF < 1 PROJECT DOES NOT QUALIFY)

STUDY: FSH

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:

F

DATE:

6/15/95

ECO TITLE:

Replace Existing Central Boilers With High Efficiency Modular Boilers

INSTALLATION:

Fort Sam Houston, San Antonio, Texas

LOCATION:

Area 2200, Building 2265

A. Summary:

Electrical Energy Savings	38	MMBTU/yr
Electrical Demand Savings	378	\$/yr
Gas Energy Savings	910	MMBTU/yr
Total Energy Savings	948	MMBTU/yr
Total Cost Savings	3,037	\$/yr
Total Investment	78,553	\$
Simple Payback	25.8	yrs
SIR	0.69	

B. ECO Description:

Remove the three existing watertube boilers and three 15 HP heating water (HW) distribution pumps in building 2265, which are serving four large buildings in the 2200 area. Install two new modular high efficiency boilers, rated at 1,830 MBH and 915 MBH output, and two new HW distribution pumps, one rated at 7 ½ HP and the other at 5 HP. Connect the new boilers and pumps to the distribution piping at the existing boiler and pump locations. The existing electrical service and controls should be reused as much as possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. The boilers and pumps should be sequenced to operate only as needed to maintain the supply water temperature setpoint of approximately 180°F. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and pumps, and installation of the new boilers, pumps, associated wiring and controls.

C. Discussion:

The three existing watertube boilers serving the 2200 area buildings were installed in 1988 and are rated at 2,240 MBH output capacity each. The three 15 HP pumps circulate HW from these boilers through buildings 2263, 2264, 2265 and 2266. All these boilers appear to be in fair condition. Computer simulations of the four buildings served by these boilers determined that the current combined capacity of 6,720 MBH is over two times the amount required to adequately heat the buildings⁶. The existing boilers are therefore operating at an inefficient, low load condition most of the time. Also, because of the constant flow rate requirements of the boilers, excessive pumping energy is expended. By staging two new high efficiency modular boilers to operate only as needed, a substantial energy savings can be realized. Also, a decrease in the combined boiler output capacity to 2,745 MBH is recommended to more closely match the heating load in the buildings and reduce the associated pumping energy consumption.

D. Savings Calculations:

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pumps were calculated using the Trace 600 computer program⁷. The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models⁸.

The two new high efficiency, modular type boilers modeled were rated at 1,830 MBH and 915 MBH output. Full and part load performance data from Aerco International were used in the computer simulations of the new boiler energy usages⁹. An equipment list with specific data on the new boilers and pumps used in the computer simulation is shown on page E-9.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings¹⁰. These savings calculations are shown on page E-10. The demand and energy savings values were used in the life cycle cost analysis for this ECO. The results of these savings calculations were as follows:

New Boiler Type	Gas	Electrical	Demand
	Savings	Savings	Savings
	MMBTU/yr	MMBTU/yr	\$/yr
Modular, High Efficiency	910	38	378

E. Cost Estimates

The total installation costs for this ECO were estimated on page E-11. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-12. The data from the life cycle cost analysis were included in the summary on page E-7.

REFERENCES

- 6. See Appendix B for Area 2200 heating system load profile.
- See Appendix B for computer model input assumptions and data, and energy consumption output data.
- See Appendix C for building field data and existing HVAC system data.
- 9. See Appendix G for manufacturer's equipment performance data from Aerco International.
- 10. See Appendix A for utility cost analysis data, used in the savings calculations.

	L USE	Z C	3,983	26						
	ANNUAL USE	KWH			24,326	16,203				
	ES.	WKS	26	26	26	26				
500	OPER. TIMES	DAYS	7	7	7	7				
REA 2	o S	HRS	24	24	24	24				
M HOUSTON,	FULL	LOAD	2,000 MBH	1,000 MBH	5.60 KW	3.73 KW				
O-F, FORT SA	YEAR	INSTALLED	New	New	New	New				
MENT LIST FOR: ECO- JUNE 2, 1995	ARFA SFRVED		Area 2200	Area 2200	Area 2200	Area 2200				
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-F, FORT SAM HOUSTON, AREA 2200	NOITGIBOSEO		Aerco #KC-2000 GWB natural draft, watertube 1830 MBH output	Aerco #KC-1000 GWB natural draft, watertube 915 MBH output	166 gpm, 110 ft 7.5 HP	83 gpm, 110 ft 5 HP				
	21		-	-	-	1				
	TEM		Hot Water Boiler	Hot Water Boiler	Heating Water Pump	Heating Water Pump				

2200 AREA

ITEM				EXIS		ENTRA LY PEAK			ANT				ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(17471)	(IVICT)
Watertube Boiler														4,936
Watertube Boiler														13
HW Pump	11.2	11.2	11.2	11.2							11.2	11.2	48,609	
HW Pump	0.6	0.6	0.6	0.6							0.6	0.6	2,433	
HW Pump	11.2	11.2										11.2	470	
HW Pump	0.6	0.6										0.6	24	
Totals	23.6	23.6	11.8	11.8							11.8	23.6	51,536	4,949
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	177	177	89	89							89	177		

Total Demand

797 \$/yr

Total Energy

176 MMBTU/yr

(electric)

Total Energy

4,949 MMBTU/yr

(gas)

ITEM		ECO-I	F: NEV	V CEN		IIGH EI LY PEAK			ODULA	AR BOI	LERS		ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Modular Boiler														3,983
Modular Boiler														56
HW Pump	5.6	5.6	5.6	5.6							5.6	5.6	24,326	
HW Pump	3.7	3.7	3.7	3.7							3.7	3.7	16,203	
Total (KW)	9.3	9.3	9.3	9.3							9.3	9.3	40,529	4,039
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	70	70	70	70							70	70		

Total Demand

419 \$/yr

Demand Savings

378 \$/yr

Energy Savings

38 MMBTU/yr

(electric)

Energy Savings

910 MMBTU/yr

ENGINEER'S ESTIMATE OF PROBABLE COST

CHECKED BY: 03-0185.04 PROJECT NO: AREA 2200, BUILDING 2265, FORT SAM HOUSTON LOCATION:

KLK

6/16/95

DATE:

BY: PIEPER, C.A.

ECO-F, Replace Existing Central Boilers With High Efficiency Modular Boilers PROJECT DESCRIPTION:

	OUA OUA	QUANTITY		LABOR		MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Remove Boiler	ы	EA	60.00	\$24.64	\$4,435	\$500.00	\$1,500	\$5,935
Remove Pump	ы	EA	6.00	\$24.64	\$444			\$444
Install New Boiler								
AFRCO # KC 2000 GWB Natural Draft. Water Tube 1830 MBH	+	EA	81.00	\$24.64	\$1,996	\$18,001.00	\$18,001	\$19,997
AFROO # KC 1000 GWB Natural Draft. Water Tube 915 MBH	-	EA	40.00	\$24.64	\$986	\$12,000.00	\$12,000	\$12,986
Leatell New Pirms 75. Ho		EA	11.00	\$24.64	\$271	\$1,669.00	\$1,669	\$1,940
Horal New Plans R O HP	-	EA	10.00	\$24.64	\$246	\$1,600.00	\$1,600	\$1,846
Pine Agaembly & valves Boiler	-	JOB	42.00	\$24.64	\$1,035	\$3,600.00	\$3,600	\$4,635
Pine Agaembly & valves Pimp	2	EA	9.00	\$24.64	\$444	\$350.00	\$700	\$1,144
Boiler Breaching Stainless attect	5	I.F	2.00	\$24.64	\$1,971	\$147.00	\$5,880	\$7,851
Reconnect Controls	-	JOB	20.00	\$24.64	\$493	\$55.00	\$55	\$548
Reconnect Flectrical	-	JOB	16.00	\$24.64	\$394	\$200.00	\$200	\$594
Reconnect Chemical system	-	JOB	10.00	\$24.64	\$246	\$50.00	\$50	\$296
Test , Balance & Start-up	-	67	20.00	\$24.64	\$493			\$493

HUITT-ZOLLARS, INC.

(817) 335-3000 * FAX (817) 335-1025 FORT WORTH, TEXAS 76102-3922 **ENGINEERS / ARCHITECTS** 512 MAIN STREET, SUITE 1500

	SUBTOTAL	\$13,454	\$45,255	\$58,709
O&P@20%	*		\$9,051	\$11,742
	SUBTOTAL	\$16,145	\$54,306	\$70,451
DESIGN @ 6%	*			\$4,227
	SUBTOTAL			\$74,678
SIOH @ 5.5%				\$3,875
	TOTAL			\$78,553

STUDY: FSH ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-F ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 70451. B. SIOH 3875. C. DESIGN COST \$ 4227. D. TOTAL COST (1A+1B+1C) \$ 78553. E. SALVAGE VALUE OF EXISTING EQUIPMENT S F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 78553. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS(5) A. ELECT \$ 6.28 38. 239. 15.08 3599. 0. B. DIST \$.00 18.57 0. 0. C. RESID \$.00 0. 0. 21.02 0. 910. 2421. D. NAT G \$ 2.66 18.58 \$ 44975. E. COAL S .00 0. 16.83 0. 0. F. PPG .00 0. 17.38 0. 0. M. DEMAND SAVINGS 378. 14.88 5625. 948. \$ N. TOTAL 3037. 54198. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 0. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 0. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCNT DISCOUNTED COST(-) ITEM oc FACTR SAVINGS(+)/ (1)(2) (3) COST(-)(4)d. TOTAL 0. 0. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 0. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 3037. 5. SIMPLE PAYBACK PERIOD (1G/4) 25.86 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 54198. 7. SAVINGS TO INVESTMENT RATIO .69 (SIR) = (6 / 1G) =

LIFE CYCLE COST ANALYSIS SUMMARY

(IF < 1 PROJECT DOES NOT QUALIFY)

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:

G

DATE:

6/15/95

ECO TITLE:

Replace Existing Individual Building Chillers With Central Chiller Plant

INSTALLATION:

Fort Sam Houston, San Antonio, Texas

LOCATION:

Quadrangle Area

A. Summary:

Electrical Energy Savings	2,212	MMBTU/yr
Electrical Demand Savings	14,116	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	2,212	MMBTU/yr
Total Cost Savings	39,257	\$/yr
Total Investment	824,178	\$
Simple Payback	20.9	yrs
SIR	0.71	

B. ECO Description:

Remove the seven existing air cooled, reciprocating chillers serving buildings 4015, 56, 16 and 44. Install a chilled water supply and return piping loop between the buildings in this area and terminate loop behind building 56, near the existing air cooled chiller installation. Install two new 275 ton, air cooled screw chillers in that location. Install two new 30 HP chilled water distribution pumps by new chillers to circulate water from new chillers through new distribution loop. Construct 10' high stone wall around new chiller plant to match local historical architecture. The existing chilled water pumps that serve buildings where chillers were removed will be reused to circulate chilled water from the new loop through the buildings. These existing pumps should be connected into the new distribution piping at the existing chiller locations. All new controls and electrical services should be installed at building 56 to serve the new central chillers and pumps. Other specific requirements should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing chillers and installation of the new chillers, associated wiring and controls.

C. Discussion:

The seven existing air cooled, reciprocating chillers in the Quadrangle area were installed between 1983 and 1994. They serve as the primary cooling systems for the four historically significant buildings. They generally appear to be in fair condition at this time. However, the cost of maintaining so many chillers is excessive and difficult for the maintenance staff. It is recommended that a central chiller plant, consisting of two air cooled screw machines be installed to serve all these buildings. This will not only save energy but will also reduce the maintenance costs to the installation. Computer simulations of the buildings in this area determined that the current installed capacity of 565 tons is slightly more than is required to adequately cool the buildings¹. Therefore, it is recommended that the two new chillers be rated at a combined 550 tons to more closely match the cooling load of the buildings.

D. Savings Calculations:

1. Energy Consumption And Savings

The monthly peak demand and energy consumptions of the existing and proposed chillers and pumps were calculated using the Trace 600 computer program². The buildings served by the existing chillers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models³.

The 275 ton air cooled screw chillers which were modeled by the computer had better part load performance ratings than reciprocating machines and were chosen for that reason. Full and part load performance data from McQuay Incorporated were used in the computer simulations of the new chiller energy usages. An equipment list of the specific chillers and pumps modeled for the new central plant are shown on page E-15.

Once the computer simulations of the existing and new chiller plants were completed, the total annual demand cost and energy consumption of the new central plant was compared with that of the existing individual systems to determine the annual savings for this ECO⁴. These savings calculations are shown on page E-16. These demand and energy savings values were used in the life cycle cost analysis.

2. Maintenance Cost Savings:

Maintenance cost estimates were obtained from a local maintenance contractor and were used to estimate the maintenance savings from reducing the total number of air cooled chillers in this area from seven down to two⁵. Based on an annual maintenance cost of \$2,250 per chiller, the total maintenance cost savings from this ECO is estimated to be \$11,250 per year. This figure was used in the life cycle cost analysis.

E. Cost Estimates

The total installation costs for the new central chiller plant were estimated on page E-17. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-18. The data from the summary sheet were presented in the ECO summary on page E-13.

REFERENCES

- 1. See Appendix B for Quadrangle Area cooling system load profile.
- 2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 3. See Appendix C for building field data and existing HVAC system data.
- 4. See Appendix A for utility cost analysis data, used in the savings calculations.
- 5. See Appendix G for maintenance contractor cost estimates for air cooled chillers.

	ANNUAL USE KWH MCF	_	253,553	98,830	25,759				
	WKS		56	56	56				
E AREA	OPER. TIMES HRS DAYS WKS	7	7	7	7				
RANGL	OPE	24	24	24	24				
ECO-G, FORT SAM HOUSTON, QUADRANGLE AREA JUNE 2, 1995	FULL	351 KW	351 KW	22.38 KW	22.38 KW				
FORT SAM HG	YEAR	New	New	New	New				
r LIST FOR: ECO-G, JUNE 2, 198	AREA SERVED	Quadrangle Area	Quadrangle Area	Quadrangle Area	Quadrangle Area				
PROPOSED HVAC EQUIPMENT LIST FOR:	DESCRIPTION	McQuay, electric air cooled, single screw 275 Tons, R-134a	McQuay, electric air cooled, single screw 275 Tons, R-134a	660 gpm, 120 ft 30 HP	660 gpm, 120 ft 30 HP				
PR	ΩTY.	-	-	1	-				
	ITEM	Water Chiller	Water Chiller	Chilled Water Pump	Chilled Water Pump				

QUADRANGLE AREA

ITEM			E	EXISTI	NG IND MONTH				LANTS				ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	((((((((((((((((((((((((((((((((((((((((MCF)
Water Chiller					83.1	86.8	90.0	89.3	83.4	76.9			180,278	
Water Chiller					36.9	40.4	43.9	44.1	37.5	27.4			76,755	
Water Chiller					159.0	185.9	188.5	189.2	166.5	157.2			393,031	
Water Chiller					155.6	170.6	184.6	185.3	160.4	119.9			122,759	
Water Chiller					98.2	106.1	113.6	115.1	103.4	93.6			296,194	
Water Chiller					143.1	155.5	166.4	168.7	151.4	137.2			243,230	
Water Chiller					143.1	155.5	166.4	168.7	151.4	121.0			104,234	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			16,472	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			16,472	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			16,472	
CHW Pump					5.6	5.6	5.6	5.6	5.6	5.6			24,730	
CHW Pump					5.6	5.6	5.6	5.6	5.6	5.6			24,730	
CHW Pump					14.9	14.9	14.9	14.9	14.9	14.9			65,887	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			7,822	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			3,036	
Evap. Condenser					9.3	9.3	9.3	9.3	9.3	9.3			41,201	
Totals					872.9	954.7	1007.3	1014.3	907.9	787.1			1,633,303	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)					6,547	9,547	10,073	10,143	9,079	5,903				

Total Demand

51,292 \$/yr

Total Energy

5,574 MMBTU/yr

(electric)

Total Energy

MMBTU/yr

(gas)

ITEM		EC	:O-G:	NEW C	ENTRA MONTH				REW C	HILLEF	RS		ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jui	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Water Chiller					287.6	328.3	351.0	351.0	306.5	271.9			607,003	
Water Chiller					287.6	328.3	351.0	351.0	306.5	216.4			253,553	
CHW Pump					22.4	22.4	22.4	22.4	22.4	22.4			98,830	
CHW Pump					22.4	22.4	22.4	22.4	22.4	22.4			25,759	
Total (KW)					620.0	701.4	746.8	746.8	657.8	533.1			985,145	
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		-
Cost (\$)					4,650	7,014	7,468	7,468	6,578	3,998				

Total Demand

37,176 \$/yr

Demand Savings Energy Savings 14,116 \$/yr

2,212 MMBTU/yr

(electric)

Energy Savings

MMBTU/yr

ENGINEER'S ESTI	MATE	OF	PRC	BAB	ESTIMATE OF PROBABLE COST	ST		
LOCATION:		PROJE	PROJECT NO:		03-0185.04		DATE:	6/16/95
QUAD AKEA, FORI SAM HOUSION		BY:	PIEPER, (PIEPER, C.A./KOTHMANN,K.	MANN,K.	CH	снескер ву:	WHW
PROJECT DESCRIPTION: ECO-G, Replace Existing Individual Building Chillers With Central Chiller Plant	ual Build	ling Chil	lers With	ı Central	Chiller Plan	4		
	QUAN	QUANTITY		LABOR	R	MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Prefabricated Inulated ConduitSCH 40 BIK Stl Pipe W/ PVC Jacket				\$24.64				
<u>~</u>	2556	LF	1.28	\$24.64	\$80,614	\$17.88	\$45,701	\$126,315
4"	500	LF	1.04	\$24.64	\$12,813	\$15.96	096'1\$	\$20,793
2-1/2"	588	LF	0.94	\$24.64	\$13,619	\$12.54	\$7,374	\$20,993
Chiller Yard Enclosure 40' X 40' W/ Steel Gate 10'-0" High	-	JOB		\$24.64	\$11,291		\$38,707	\$49,998
Stone Vent Wall (12" X 12" X 18") Historicly Correct								
Water Chiller Air Cooled 275 TON Single Screw W/ Pipe Assembly	2	EA	1420.00	\$24.64	\$69,978	00.000,66\$	\$198,000	\$267,978
Chilled Water Pump 660 GPM X 120' 30 HP W/ Pipe Assembly	2	EA	27.50	\$24.64	\$1,355	\$3,300.00	\$6,600	\$7,955
Connect to Existina Hydronic System	4	BLDG	75.00	\$24.64	\$7,392	\$2,800.00	\$11,200	\$18,592
Controls / Test & Ballance	-	JOB	90.00	\$24.64	\$2,218	\$6,500.00	\$6,500	\$8,718
Remove Chiller & CW pump (50 Ton) BLDG 4015	-	JOB	80.00	\$24.64	\$1,971	\$100.00	\$100	\$2,071
Remove Chiller & CW pump (30 Ton) BLDG 56	1	JOB	48.00	\$24.64	\$1,183	\$100.00	\$100	\$1,283
Remove Chiller & CW pump (110 Ton) BLDG 16	-	JOB	150.00	\$24.64	\$3,696	\$200.00	\$200	\$3,896
Remove Chiller & CW pump (120 Ton) BLDG 10	-	JOB	150.00	\$24.64	\$3,696	\$200.00	\$200	\$3,896
Remove Chiller & CW pump BLDG 44	255	TON	1.49	\$24.64	\$9,362	\$1.50	\$383	\$9,745
Remove Condenser Pump Bida 16	33	EA	00.9	\$24.64	\$444	\$100.00	\$300	\$744
Electrical	1	JOB					\$73,000	\$73,000
			3,	SUBTOTAL	\$219,632		\$396,345	\$615,977
ONI SAVI IOZ TITILI			O&P@20%	%1	\$43,926		\$79,269	\$123,195
HOLLI-COLLAND, INC.				SUBTOTAL	\$263.558		\$475,614	\$739,172

512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922 (817) 335-3000 * FAX (817) 335-1025

ENGINEERS / ARCHITECTS

\$739,172 \$44,350 \$783,522 \$40,654 \$824,176

\$475,614

SUBTOTAL \$263,558

TOTAL

SUBTOTAL

SIOH @ 6.5%

DESIGN @ 6%

LCCID FY95 (92) ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3 PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-G ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER 1. INVESTMENT A. CONSTRUCTION COST 739172. B. SIOH 40655. C. DESIGN COST Ŝ 44351. D. TOTAL COST (1A+1B+1C) \$ 824178. E. SALVAGE VALUE OF EXISTING EQUIPMENT \$ F. PUBLIC UTILITY COMPANY REBATE 0. G. TOTAL INVESTMENT (1D - 1E - 1F) 824178. 2. ENERGY SAVINGS (+) / COST (-) DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994 UNIT COST SAVINGS ANNUAL \$ DISCOUNT DISCOUNTED FUEL \$/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4) SAVINGS (5) A. ELECT \$ 6.28 2212. 13891. 15.08 209482. .00 B. DIST \$ 0. 0. 18.57 0. .00 C. RESID \$ 0. 0. 21.02 0. 0. 0. D. NAT G \$ 2.66 0. 18.58 0. \$ \$ E. COAL .00 0. 16.83 0. F. PPG .00 0. 17.38 0. 0. \$ 2212. \$ 14116. M. DEMAND SAVINGS 14.88 210046. N. TOTAL 28007. 419528. 3. NON ENERGY SAVINGS(+) / COST(-) A. ANNUAL RECURRING (+/-) 11250. (1) DISCOUNT FACTOR (TABLE A) 14.88 (2) DISCOUNTED SAVING/COST (3A X 3A1) 167400. B. NON RECURRING SAVINGS(+) / COSTS(-) SAVINGS(+) YR DISCOUNTED DISCNT COST(-) ITEM OC FACTR SAVINGS(+)/ (1) (2) (3) COST(-)(4)d. TOTAL 0. 0. C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)\$ 167400. 4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))\$ 39257. 5. SIMPLE PAYBACK PERIOD (1G/4) 20.99 YEARS 6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) 586928. 7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) =.71 (IF < 1 PROJECT DOES NOT QUALIFY) **** Project does not qualify for ECIP funding; 4,5,6 for information only.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FSH

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:

Н

DATE:

6/15/95

ECO TITLE:

Replace Existing Individual Building Boilers With Central Boiler Plant

INSTALLATION:

Fort Sam Houston, San Antonio, Texas

LOCATION:

Quadrangle Area, Building 16

A. Summary:

Electrical Energy Savings	-12	MMBTU/yr
Electrical Demand Savings	122	\$/yr
Gas Energy Savings	-434	MMBTU/yr
Total Energy Savings	-446	MMBTU/yr
Total Cost Savings	5,542	\$/yr
Total Investment	394,910	\$
Simple Payback	71.2	yrs
SIR	0.20	

B. ECO Description:

Remove twelve existing steam boilers in building 44, which serve as the primary heating source for that building. Install a new condensate receiver, pump and buried piping to return condensate to the new central boiler plant in building 16. Provide new electrical connections as required for the new condensate pump.

Remove one 741 MBH hot water boiler from building 4015 which serves as the primary heating source for that building. Install a new 250 MBH steam to hot water generator in place of the boiler. The existing 3 HP distribution pump will remain to circulate heating water from the new generator through the building. Install a new condensate receiver, pump and buried piping to return condensate from the new generator to the new central boiler plant in building 16. Provide new electrical connections as required for the new condensate pump.

Remove one 1,614 MBH steam boiler from building 16, which serves only that building. The 3,587 MBH steam boiler in building 16 which serves it and building 56 shall remain and be used as a new central steam boiler for buildings 16, 56, 44 and 4015. Install a new condensate receiver and pump in the location where the other boiler was removed, and install new condensate return piping from there to the new central steam boiler plant in the building

Install new buried steam distribution piping from the new central steam boiler in the building out to buildings 4015, 44 and the area in building 16 where the other boiler was removed.. Connect existing steam distribution piping in buildings 44 and 16 to the new central steam distribution piping. Connect the new steam to hot water generator in building 4015 to the new central steam distribution piping.

C. Discussion:

The twelve existing steam boilers in building 44 were installed in 1970 and are rated at a combined 2,902 MBH output capacity. The single hot water boiler in building 4015 was installed in 1983, and the two steam boilers in building 16 were installed in 1979. All of these boilers appear to be in fair to poor condition. Computer simulations of the four buildings in the Quadrangle area determined that the current combined capacity of 8,970 MBH is over two times the amount required to adequately heat the buildings¹. The existing boilers are therefore operating at an inefficient, low load condition most of the

time. By eliminating the extra boilers in the area, maintenance cost savings can be realized. Also, a decrease in the combined boiler output capacity to 3,587 MBH is recommended to more closely match the heating load in the buildings.

D. Savings Calculations:

1. Energy Savings:

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pump were calculated using the Trace 600 computer program². The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models³. An equipment list with specific data on the new central boiler system used in the computer simulation is shown on page E-21.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings⁴. These savings calculations are shown on page E-22. The demand and energy savings values were used in the life cycle cost analysis for this ECO.

2. Maintenance Savings:

Since the total number of boilers is being reduced from fifteen down to one, there will be a substantial savings in maintenance costs. Maintenance cost estimates were obtained from a local contractor and used to estimate these savings for the installation⁵. Based on a cost annual maintenance cost of \$475 per boiler, the total estimated maintenance cost savings for this ECO is \$6,650. This figure was used in the life cycle cost analysis.

E. Cost Estimates

The total installation costs for this ECO were estimated on page E-23. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-24. The data from the life cycle cost analysis were included in the summary on page E-19.

REFERENCES

- 1. See Appendix B for Quadrangle Area heating system load profile.
- 2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 3. See Appendix C for building field data and existing HVAC system data.
- 4. See Appendix A for utility cost analysis data, used in the savings calculations.
- 5. See Appendix G for maintenance contractor cost estimates.

	ANNUAL USE	KWH MCF	1,644	9,731					
_	ES	WKS	56	26					
E ARE	OPER. TIMES	DAYS WKS	7	7					
RANGL	Q	HRS	24	24					
JUSTON, QUAE	FULL	LOAD	5,000 MBH	2.24 KW					
FORT SAM HG	YEAR	INSTALLED	Exist	Exist					
T LIST FOR: ECO-H,		AREA SERVED	Quadrangle Area	Bldg. 4015					
PROPOSED HVAC EQUIPMENT LIST FOR: ECO-H, FORT SAM HOUSTON, QUADRANGLE AREA JUNE 2, 1995		DESCRIPTION	Rite #500 natural draft, watertube 3587 MBH output	N/A 3 HP			,		
A.		Ω Y	-	-					
r.		ITEM	Steam Boiler	Heating Water Pump					

QUADRANGLE AREA

ITEM	Jan	Feb	Mar	EXISTI Apr		DIVIDU LY PEAK Jun			_ANTS	Oct	Nov	Dec	ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
Steam Boiler														651
Steam Boiler														267
Steam Boiler														103
Steam Boiler														66
Steam Boiler														3
Firetube Boiler	3.7	3.7	3.7								3.7	3.7	4,275	120
HW Pump	2.2	2.2	2.2								2.2	2.2	1,821	
Totals	5.9	5.9	5.9								5.9	5.9	6,096	1,210
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	44	44	44								44	44		

Total Demand

221 \$/yr

Total Energy

21 MMBTU/yr

(electric)

Total Energy

1,210 MMBTU/yr

(gas)

ITEM			1	ECO-H		CENT			PLANT				ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Steam Boiler														1,644
HW Pump	2.2	2.2	2.2	2.2							2.2	2.2	9,731	
Total (KW)	2.2	2.2	2.2	2.2							2.2	2.2	9,731	1,644
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	17	17	17	17							17	17		

Total Demand

99 \$/yr

Demand Savings

122 \$/yr

Energy Savings

-12 MMBTU/yr

(electric)

Energy Savings

-434 MMBTU/yr

ENGINEER'S ESTIF	IATE	9 P	PRO	ESTIMATE OF PROBABLE COST	SO2 =	⊢		
LOCATION:		PROJECT NO:	CT NO:		03-0185.04		DATE:	6/16/95
QUAD AKEA, FOKI SAM HOUSION		BY:	PIEPER,	PIEPER, C.A. / KOTHMANN,K.	ANN,K.	CH	снескер ву:	WHW
PROJECT DESCRIPTION: ECO-H, Replace Existing Individ	al Buildi	ing Boile	rs With	ing Individual Building Boilers With Central Boiler Plant	ler Plant			
	QUAN	QUANTITY		LABOR		MATE	MATERIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Condinsate Rreciever Pump Combo Unit with Pipe Assembly & Valves								
6 GPM. 60 psi. 640 lb BLDG 44	-	М	33.00	\$24.64	\$813	\$4,600.00	\$4,600	\$5,413
1.5 GPM, 30psi, 2451b / hr, BLDG 4015	-	EA	16.60	\$24.64	\$409	\$2,700.00	\$2,700	\$3,109
6 GPM, 60 psi, 640 lb / hr. BLDG 16	-	EA	33.00	\$24.64	\$813	\$4,600.00	\$4,600	\$5,413
Electrcal Connections & Motor Feeders	1	308	81.00	\$24.64	\$1,996	\$1,800.00	\$1,800	\$3,796
Prefabricted Insulated Conduit sch 80 STL Carrier 2" insul. PVC Jacket								
2-1/2" with Fittings Trench & Backfill	2375	LF	0.94	\$24.64	600'55\$	\$15.70	\$37,288	\$92,297
1-1/2" with Fittings Trench & Backfill	250	4	0.84	\$24.64	\$5,174	\$13.60	\$3,400	\$8,574
I" with Fittings Trench & Backfill	100	片	62.0	\$24.64	\$1,947	\$12.75	\$1,275	\$3,222
Connect to Existing Hydronic System	4	BLDG	40.00	\$24.64	\$3,942	\$2,150.00	\$8,600	\$12,542
Prefabricted Insulated Conduit sch 40 STL Carrier I" insul. PVC Jacket								
2" with Fittings Trench & Backfill	2,375	LF	0.81	\$24.64	\$47,401	\$11.75	\$27,906	\$75,307
1-1/2" with Fittings Trench & Backfill	250	LF	0.78	\$24.64	\$4,805	\$10.54	\$2,635	\$7,440
I" with Fittings Trench & Backfill	100	LF	0.76	\$24.64	\$1,873	\$9.37	\$937	\$2,810
Reuse 3 HP Hot Water Pump Blgd 4015	1	EA	13.20	\$24.64	\$325	\$345.00	\$345	\$670
Steam to Hot Water Generator, 250 MBH, bldg 4015	1	EA	15.65	\$24.64	\$386	\$1,500.00	\$1,500	\$1,886
Remove Boiler & Pipina	15	EA	137.00	\$24.64	\$50,635	\$225.00	\$3,375	\$54,010
Controls and Test & Balance	ß	BLDG	50.00	\$24.64	\$6,160	\$2,500.00	\$12,500	\$18,660
				SUBTOTAL	\$181,688		\$113,461	\$295,149
ONI SAN INC			O&P@20%	%(\$36,338		\$22,692	020'69\$

\$354,179 \$21,251 \$375,430 \$19,480 \$394,910

\$136,153

HUITT-ZOLLARS, INC.

SUBTOTAL \$218,026

TOTAL

SUBTOTAL

SIOH @ 5.5%

(817) 335-3000 * FAX (817) 335-1025 512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922 **ENGINEERS / ARCHITECTS**

DESIGN @ 6%

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STUDY: FSH
        ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
                                                        LCCID FY95 (92)
   INSTALLATION & LOCATION: FSH
                                        REGION NOS. 6 CENSUS: 3
   PROJECT NO. & TITLE: 03018504
                                    EEAP BOILER CHILLER STUDY
   FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-H
   ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER
   1. INVESTMENT
   A. CONSTRUCTION COST
                                354179.
   B. SIOH
                                19480.
   C. DESIGN COST
                            Ś
                                21251.
   D. TOTAL COST (1A+1B+1C) $ 394910.
   E. SALVAGE VALUE OF EXISTING EQUIPMENT S
   F. PUBLIC UTILITY COMPANY REBATE
                                                0.
   G. TOTAL INVESTMENT (1D - 1E - 1F)
                                                         394910.
   2. ENERGY SAVINGS (+) / COST (-)
   DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994
               UNIT COST SAVINGS ANNUAL $ DISCOUNT
                                                              DISCOUNTED
               $/MBTU(1) MBTU/YR(2) SAVINGS(3) FACTOR(4)
       FUEL
                                                              SAVINGS(5)
       A. ELECT $ 6.28
                                             <del>-</del>75.
                              -12.
                                                       15.08
                                                                   -1136.
                                0.
                  .00
       B. DIST $
                                               0.
                                                       18.57
                                                                       0.
                  .00
       C. RESID $
                               0.
                                                      21.02
                                              0.
                                                                       0.
                           -434.
0.
0.
       D. NAT G $ 2.66
                                       $ -1154.
                                                      18.58
                                                                 -21449.
                             0. $
0. $
-446. $
                                           0.
       E. COAL $
                  .00
                                                      16.83
                                                                       0.
       F. PPG $
                   .00
                                                      17.38
                                               0.
                                                                       0.
       M. DEMAND SAVINGS
                                                       14.88
                                            122.
                                                                    1815.
       N. TOTAL
                                           -1108.
                                                                  -20771.
   3. NON ENERGY SAVINGS(+) / COST(-)
      A. ANNUAL RECURRING (+/-)
                                                                    6650.
          (1) DISCOUNT FACTOR (TABLE A)
                                                      14.88
          (2) DISCOUNTED SAVING/COST (3A X 3A1)
                                                                   98952.
      B. NON RECURRING SAVINGS(+) / COSTS(-)
                              SAVINGS(+) YR
                                                        DISCOUNTED
SAVINGS(+)/
COST(-)(4)
                                               DISCNT
                                COST(-)
                  ITEM
                                          OC
                                               FACTR
                                   (1)
                                          (2)
                                               (3)
       d. TOTAL
                                   0.
      C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 98952.
   4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 5542.
   5. SIMPLE PAYBACK PERIOD (1G/4)
                                                                71.26 YEAR
   6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)
                                                                   78181.
   7. SAVINGS TO INVESTMENT RATIO
                                         (SIR) = (6 / 1G) =
                                                                   .20
       (IF < 1 PROJECT DOES NOT QUALIFY)
**** Project does not qualify for ECIP funding; 4,5,6 for information only.
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LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO: J

DATE: 6/15/95

ECO TITLE: Replace Existing Individual Building Boilers With Central Boiler Plant

INSTALLATION: Fort Sam Houston, San Antonio, Texas

LOCATION: Area 100, Building 250

A. Summary:

186 MMBTU/yr **Electrical Energy Savings Electrical Demand Savings** 680 \$/vr Gas Energy Savings 680 MMBTU/yr **Total Energy Savings** 866 MMBTU/vr **Total Cost Savings** 11,483 \$/yr 273,951 \$ **Total Investment** Simple Payback 23.8 yrs SIR 0.66

B. ECO Description:

Remove fourteen existing hot water boilers in buildings 122, 124, 128, 133, 134, 142, 143, 144, 146, 147, 149, 197, 198 and 199 which serve as the primary heating source for those buildings. Remove the two existing steam boilers in building 250. Install two new central hot water boilers rated at 563 MBH and 1250 MBH output. Locate these new boilers outside of building 250, near existing air cooled chiller installation. Install new 3 ½ inch hot water supply and return piping between the buildings in the 100 area and terminate loop at the new boiler locations behind building 250. Install new 10 HP and 15 HP heating water pumps at that location to circulate HW from the new central boilers through the new distribution loop. Reconnect individual building HW pumps to new central HW distribution piping at existing boiler locations and reuse pumps to circulate HW from loop through buildings. Provide new electrical service for new boilers as required. Other specifications in these areas should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and installation of the new boilers, pumps, distribution loop, associated electrical services and controls.

C. Discussion:

The sixteen existing boilers in Area 100 were installed in 1985 and are rated at a combined 8,829 MBH output capacity. All of these boilers appear to be in fair condition. Computer simulations of the 100 Area buildings determined that the current combined capacity is nearly five times the amount required to adequately heat the buildings¹. The existing boilers are therefore operating at an inefficient, low load condition most of the time. By eliminating the extra boilers in the area, energy and maintenance cost savings can be realized. Also, a decrease in the combined boiler output capacity to 1,813 MBH is recommended to more closely match the heating load in the buildings.

D. Savings Calculations:

1. Energy Savings:

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pumps were calculated using the Trace 600 computer program². The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the

buildings were used to create these computer building models³. An equipment list with specific data on the new central boiler system used in the computer simulation is shown on page E-27.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings⁴. These savings calculations are shown on pages E-28 through E-29. The demand and energy savings values were used in the life cycle cost analysis for this ECO.

2. Maintenance Savings:

Since the total number of boilers is being reduced from sixteen down to two, there will be a substantial savings in maintenance costs. Maintenance cost estimates were obtained from a local contractor and used to estimate these savings for the installation⁵. Based on a cost annual maintenance cost of \$475 per boiler, the total estimated maintenance cost savings for this ECO is \$6,650. This figure was used in the life cycle cost analysis.

E. Cost Estimates

The total installation costs for this ECO were estimated on page E-30. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-31. The data from the life cycle cost analysis were included in the summary on page E-25.

REFERENCES

- 1. See Appendix B for 100 Area heating system load profile.
- 2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
- 3. See Appendix C for building field data and existing HVAC system data.
- 4. See Appendix A for utility cost analysis data, used in the savings calculations.
- 5. See Appendix G for maintenance contractor cost estimates.

ш	MCF	756	491						
ANNUAL USE	KWH			30,802	4,454				
ES	WKS	26	26						
OPER. TIMES	DAYS	7	7						
OP	HRS	24	24						
FULL	LOAD	750 MBH	1,666 MBH	7.46 KW	11.19 KW				
% YEAR	INSTALLED	New	New	New	New	·			
JUNE 2, 19	AREA SERVED	Area 100	Area 100	Area 100	Area 100				
	DESCRIPTION	Teledyne Laars natural draft, watertube 563 MBH output	Teledyne Laars natural draft, watertube 1250 MBH output	57 gpm, 150 ft 10 HP	125 gpm, 150 ft 15 HP				
	o FT	-	-	-	_				
	ITEM	Hot Water Boiler	Hot Water Boiler	Heating Water Pump	Heating Water Pump				

100 AREA

ITEM			i		NG INE				ANTS				ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Watertube Boiler														193
Watertube Boiler														226
Watertube Boiler														82
Firetube Boiler	3.7	3.7	3.7	3.7							3.7	3.7	16,203	177
Watertube Boiler														76
Watertube Boiler														190
Watertube Boiler														112
Watertube Boiler														112
Watertube Boiler														116
Watertube Boiler														116
Watertube Boiler														89
Watertube Boiler														38
Watertube Boiler														99
Steam Boiler														172
Watertube Boiler														58
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	3,377	
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	4,865	
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	4,865	
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	4,865	
HW Pump	0.4	0.4	0.4	0.4							0.4	0.4	1,607	
HW Pump	0.4	0.4	0.4	0.4							0.4	0.4	1,607	
HW Pump	0.4	0.4	0.4	0.4							0.4	0.4	1,039	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	1,904	
HW Pump	0.8	8.0	8.0	0.8							0.8	0.8	1,904	
HW Pump	0.8	8.0	8.0	0.8							0.8	0.8	1,904	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	2,136	
HW Pump	0.8	0.8	0.8	0.8							8.0	0.8	2,136	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	1,257	
HW Pump	0.6	0.6	0.6	0.6							0.6	0.6		
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	4,865	
HW Pump	0.4	0.4	0.4	0.4							0.4			
Gas Furnace	11.3	11.3	11.3	11.3							11.3			
Gas Furnace	0.7	0.7	0.7	0.7							0.7	0.7		
Totals	28.2	28.2	28.2	28.2							28.2	28.2	89,804	1,927
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50		1	
Cost (\$)	212	212	212	212							212		1	

Total Demand

1,269 \$/yr

Total Energy

307 MMBTU/yr

(electric)

Total Energy

1,927 MMBTU/yr

100 AREA

ITEM				ECO-J:			RAL BO		PLANT				ANNUAL ENERGY USAGE	ANNUAL ENERGY USAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(KWH)	(MCF)
Watertube Boiler														75 6
Watertube Boiler														491
HW Pump	7.5	7.5	7.5	7.5							7.5	7.5	30,802	
HW Pump	11.2	11.2										11.2	4,454	
Total (KW)	18.7	18.7	7.5	7.5							7.5	18.7	35,256	1,247
Rate (\$/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost (\$)	140	140	56	56							56	140		

Total Demand

590 \$/yr

Demand Savings

680 **\$**/yr

Energy Savings

186 MMBTU/yr

(electric)

Energy Savings

680 MMBTU/yr

ENGINEER'S ESTI	MAT	E OF	PR(ESTIMATE OF PROBABLE COST	E CO	ST		
LOCATION:		PROJE	PROJECT NO:		03-0185.04		DATE:	6/16/95
AREA 100, FORT SAM HOUSTON		BY:	PIEPER, C.A.	.C.A.		CH	снескер ву:	KLK
PROJECT DESCRIPTION: ECO-J, Replace Existing Indivi	dual Bu	ilding Bo	ilers Wi	sting Individual Building Boilers With Central Boiler Plant	Boiler Plan	4		
	l g	QUANTITY		LABOR		MATERIAL	RIAL	TOTAL
ITEM DESCRIPTION	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	COST
Prefabricated Conduit 3-1/2" Trench & backfill	2950	O LF		\$24.64	\$72,688	\$14	\$41,300	\$113,988
	5	EA	\$	\$24.64	\$15,770	\$500	\$8,000	\$23,770
Reconnect Pump to Site Distribution	5	EA	8	\$24.64	\$3,154	\$780	\$12,480	\$15,634
Track of New Boiler 503 MBH	-	EA	58	\$24.64	\$1,429	\$5,600	\$5,600	\$7,029
Install New Boiler 1250 MBH	-	EA	69	\$25.64	\$1,769	\$8,500	\$8,500	\$10,269
Tratal New Pimp 10 HP	-	EA	ट्	\$24.64	\$370	\$1,800	\$1,800	\$2,170
Inatall New Pump 15 HP	-	E	15	\$24.64	\$370	\$1,900	\$1,900	\$2,270
nine Assembly & valves Boiler	2	EA	28	\$24.64	\$1,380	\$2,400	\$4,800	\$6,180
pipe Aggembly & valves Pump	2	Ë	12	\$24.64	\$591	\$350	\$700	\$1,291
Boiler Breachina	-	JOB	36	\$24.64	\$887	\$3,000	\$3,000	\$3,887
Controla	-	JOB	160	\$24.64	\$3,942	006'9\$	\$6,900	\$10,842
THE TEST OF THE TE	-	JOB	30	\$26.64	\$799	\$290	065\$	\$1,389
Chemical Shot Feed	-	JOB	5	\$26.64	\$426	\$1,500	\$1,500	\$1,926
diameter order								44,000
Teet , Balance & Start-up	-	टी	9	\$25.64	\$4,102			44,102
	-							
				SUBTOTAL	\$107,677		010,76\$	\$204,747
OM SOA LICE THE			0 & P @	@ 20%	\$21,535		\$19,414	\$40,949
HOII I-COLLARS, INC.				SUBTOTAL	\$129,212		\$116,484	\$245,696
ENGINEERS / ARCHITECTS			DESIGN @ 6%	%9 @				\$14,742
512 MAIN STREET, SUITE 1500				SUBTOTAL				\$260,438
(817) 335-3000 * FAX (817) 335-1025			SIOH @ 6.6%	2.6%				\$13,513
	1			TOTAL				\$273,951

APPENDIX F

(EEAP) BOILER AND CHILLER STUDY SCOPE OF WORK AND REVIEW COMMENTS CESAM-EN-DM January 1995

GENERAL SCOPE OF WORK

FOR A

LIMITED ENERGY STUDY

Performed as part of the ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

SCOPE OF WORK FOR A LIMITED ENERGY STUDY

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ANNEXES

- A DETAILED SCOPE OF WORK
- B -- EXECUTIVE SUMMARY GUIDELINE
- C -- REQUIRED DD FORM 1391 DATA

- 1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (AE) shall:
- 1.2 Perform a limited site survey of specific buildings or areas to collect all data required to evaluate the specific ECOs included in this study.
- 1.4 Evaluate specific ECOs to determine their energy savings potential and economic feasibility.
- 1.5 Provide project documentation for recommended ECOs as detailed herein.
- 1.6 Prepare a comprehensive report to document all work performed, the results and all recommendations. \cdot

2. GENERAL

- 2.1 This study is limited to the evaluation of the specific buildings, systems, or ECOs listed in Annex A, DETAILED SCOPE OF WORK.
- 2.2 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study.
- 2.3 For the buildings, systems or ECOs listed in Annex A, all methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination.
- 2.4 The study shall consider the use of all energy sources applicable to each building, system, or ECO.
- 2.5 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from DAIM-FDF-U, dated 10 Jan 1994 (including current updates) establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. The program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. If any program other than LCCID is proposed for life cycle cost analysis, it must use the mode of calculation specified

in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to the Contracting Officer.

- 2.6 Computer modeling will be used to determine the energy savings of ECOs which would replace or significantly change an existing heating, ventilating, and air-conditioning (HVAC) system. The requirement to use computer modeling applies only to heated and air-conditioned or air-conditioned-only buildings which exceed 8,000 square feet or heated-only buildings in excess of 20,000 square feet. Modeling will be done using a professionally recognized and proven computer program or programs that integrate architectural features with air-conditioning, heating, lighting and other energy-producing or consuming systems. These programs will be capable of simulating the features, systems, and thermal loads of the building under study. The program will use established weather data files and may perform calculations on a true. hour-by-hour basis or may condense the weather files and the number of calculations into several "typical" days per month! The Detailed Scope of Work, Annex A, will list programs that are acceptable to the Contracting Officer. If the AE desires to use a different program, it must be submitted for approval with a sample run, an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities.
- 2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP or FEMP funding, and determining in coordination with installation personnel the appropriate packaging and implementation approach for all feasible ECOs.
- 2.7.1 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).
- 2.7.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.
- 2.7.3 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Public Works will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant.
- 2.8 Metric Reporting Requirements: In this study, the analyses of the ECOs may be performed using English or Metric units as long as they are consistent throughout the report. The final results of energy savings for individual recommended projects and for the overall study will be reported in units of MegaBTU per year and in MegaWatts per year. Paragraph 7.6.2 details requirements for the contents of the final submittal.

3. PROJECT MANAGEMENT

- 3.1 <u>Project Managers</u>. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.
- 3.2 <u>Installation Assistance</u>. The Commanding Officer or authorized representative at the installation will designate an individual to assist the AE in obtaining information and establishing contacts necessary to accomplish the work required under this contract. This individual will be the installation representative.
- 3.3 <u>Public Disclosures</u>. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.
- 3.4 <u>Meetings</u>. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE's project manager and the Government's representative shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, will be in addition to the presentation and review conferences.
- 3.5 <u>Site Visits, Inspections, and Investigations</u>. The AE shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records

- 3.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.
- 3.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this

- contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of material.
- 3.7 <u>Interviews</u>. The AE and the Government's representative shall conduct entry and exit interviews with the Director of Public Works before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.
- 3.7.1 Entry. The entry interview shall describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:
 - a. Schedules.
 - b. Names of energy analysts who will be conducting the site survey.
 - c. Proposed working hours.
 - d. Support requirements from the Director of Public Works.
- 3.7.2 Exit. The exit interview shall be held when the field work is essentially complete; it shall briefly describe the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Public Works.
- 4. <u>SERVICES AND MATERIALS</u>. All services, materials (except those specifically enumerated to be furnished by the Government), labor, supervision, and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.
- 5. PROJECT DOCUMENTATION. All energy conservation opportunities which the AE has considered shall be included in one of the following categories and presented in the report as such:
- 5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than \$300,000, a Savings to Investment Ratio (SIR) greater than 1.25 and a simple payback period of less than ten years. The overall project and each discrete part of the project shall have an SIR greater than 1.25. All projects meeting the above criteria shall be arranged as specified in paragraph 2.7.1 and shall be provided with programming documentation. Programming documentation shall consist of a DD Form 1391 and life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented). A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account

the synergistic effects of the individual ECOs.

- 5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate, but which have an SIR greater than 1.25 shall be documented. Projects or ECOs in this category shall be arranged as specified in paragraph 2.7.2 and shall be provided with the following documentation: the life cycle cost analysis (LCCA) summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA (energy savings calculations and cost estimate), and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation prepared, as required by the Government's representative, for one of the following categories:
 - a. Federal Energy Management Program (FEMP) Projects. A FEMP (or O&M Energy) project is one that results in needed maintenance or repair to an existing facility, or replaces a failed or failing existing facility, and <u>also</u> results in energy savings. The criteria are similar to the criteria for ECIP projects, ie, SIR ≥ 1.25, and simple payback period of less than ten years. Projects with a construction cost estimate up to \$1,000,000 shall be documented as outlined in par 5.2 above; projects over \$1,000,000 shall be documented on 1391s. In the FEMP program, a system may be defined as "failed or failing" if it is inefficient or technically obsolete. However, if this strategy is used to justify a proposed project, the equipment to be replaced must have been in use for at least three years.
 - b. Low Cost/No Cost Projects. These are projects which the Director of Public Works (DPW) can perform using his resources. Documentation shall be as required by the DPW.
 - 5.3 <u>Nonfeasible ECOs</u>. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.
 - 6. $\underline{\text{DETAILED}}$ $\underline{\text{SCOPE}}$ $\underline{\text{OF}}$ $\underline{\text{WORK}}$. The Detailed Scope of Work is contained in Annex A.
 - 7. WORK TO BE ACCOMPLISHED.
 - 7.2 <u>Perform a Limited Site Survey</u>. The AE shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the AE is encouraged to use any data that may have been documented in a previous study. The AE shall document his site survey on forms developed for the survey, or on

standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

- 7.4 Evaluate Selected ECOs. The AE shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratics (SIRs) shall be determined using current ECIP guidance. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions and engineering equations shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.
- 7.5 Combine ECOs Into Recommended Projects. During the Interim Review Conference, as outlined in paragraph [7.6.1], the AE will be advised of the DEH's preferred packaging of recommended ECOs into projects for implementation. Some projects may be a combination of several ECOs, and others may contain only one. These projects will be evaluated and arranged as outlined in paragraphs 5.1, 5.2, and 5.3. Energy savings calculations shall take into account the synergistic effects of multiple ECOs within a project and the effects of one project upon another. The results of this effort will be reported in the Final Submittal per par [7.6.2].
- '7.6 <u>Submittals</u>, <u>Presentations and Reviews</u>. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections,

subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included. The AE shall give a formal presentation of the interim submittal to installation, command, and other Government personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that the presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date agreeable to the Director of Public Works, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included. The results of the ECO analyses shall be summarized by lists as follows:

a.All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed in par 5.3.

b.All ECOs which were analyzed shall be grouped into two listings, recommended and non-recommended, each arranged in order of descending SIR. These lists may be subdivided by building or area as appropriate for the study.

The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the Government's and AE's representatives shall coordinate with the Director of Public Works to provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

- 7.6.2 Final Submittal. The AE shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The AE shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The lists of ECOs specified in paragraph [7.6.1] shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:
- a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex B for minimum requirements).
- b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.
- c. Documentation for the recommended projects (includes LCCA $\mbox{\it Summary Sheets}$).
 - d. Appendices to include as a minimum:
 - Energy cost development and backup data
 - Detailed calculations
 - 3) Cost estimates
 - 4) Computer printouts (where applicable)
 - 5) Scope of Work

ANNEX A

DETAILED SCOPE OF WORK CONTRACT NO. DACAC63-94-D-0015 DELIVERY ORDER NO. 000

1. The Architect-Engineer (A-E) shall furnish all services, material, supplies, plant, labor, equipment, investigations, studies, superintendence and travel as required in connection with the below identified project for design in accordance with the original basic contract and this Detailed Scope of Work. Appendix "A" of the basic contract shall be followed for performance requirements for A-E services. Where this Detailed Scope of Work conflicts with Appendix "A", this Detailed Scope of Work shall govern.

INSTALLATION

PROJECT TITLE

Fort Sam Houston, TX

Boiler/Chiller Study (EEAP)

2. The work and other related data and services required in this Delivery Order shall be accomplished within the time schedule required, in accordance with the subject stated above and scope of work described in paragraph 3 below. The schedule for delivery of data to the Contracting Officer is in calendar days as follows:

DELIVERY SCHEDULE

- a. Interim Submittal and related data for studies (See Annex B for number of copies)
- 60 calendar days after receipt of Delivery Order

b. Pre-Final Submittal(s)

- 90 calendar days after approval of Interim submittal
- c. Final Submittal (original and all data developed under this submittal)
- 90 calendar days after approval of the pre-final
- 3. The items of work included in this Delivery Order shall be in accordance with criteria furnished at the Scoping conference held 29 June 1994 at Fort Sam Houston. The services to be provided shall include, but not be limited to, the following Scope of Work.
 - a. Items of Work:
- (1) 2200 Area. Evaluate the feasibility and economic impacts of modifying the existing cooling and heating plant in Building 2265. This plant provides heating hot water and chilled water to Buildings 2263, 2264, 2265 and 2266. The feasibility study will consider chiller replacement or retrofit and boiler

upgrade or replacement. A limited survey of the four existing buildings served by this plant will be performed to permit a qualitative verification that the existing plant capacities are adequate. The survey will also reveal constraining requirements such as year-round cooling requirements which may influence the recommendations. Chiller replacement/retrofit recommendations will consider refrigerants 123 or 134a only, gas vs. electrical driven compressors, drive configuration (i.e., open-drive vs. hermetic), operating efficiency (i.e., compressor type: screw vs. centrifugal part load and full load capacities and variable speed drive) and maintainability. The cost effects of the new design criteria from the Uniform Mechanical code which requires a partition be provided between the chiller and boiler shall be investigated. As the thermal load history for the plant is not available, a generalized load profile will be assumed and used to analyze the benefits of energy saving options and equipment selections. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.

- (2) 2200 Area (item 1 must be performed in conjunction with this item). Evaluate buildings 2263, 2264, 2265, and 2266 and model each building to develop a probable annual thermal load profile. Receive as-built drawings on the buildings from Fort Sam Houston and perform a survey of the buildings to collect information necessary to more accurately develop the annual thermal profile of each.
- (3) 2200 Area (items 1 or 1a must be performed in conjunction with this item). Evaluate the use of four-pipe heating and cooling distribution from the central plant. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment. Based on the current type of building occupancy, a determination will be provided on whether a single mode of plant operation will suit the air conditioning requirements for the group of buildings tied into the plant, as will occur in a two pipe system. Also, considering the constant changing use of the Army facilities, the firm performing the study shall provide their own engineering judgement on whether locking a facility into a particular type of occupancy (i.e., loss of flexibility) makes sense, as will also occur in a two pipe system. The fact that a complete system shut down is needed in order to perform maintenance in a two pipe system, will be addressed in the engineering judgement decision.

- 1300 Area. Evaluate the feasibility and economic impacts of modifying the existing cooling and heating plant in Building 1377. This plant provides heating hot water and chilled water to Buildings 1350, 1374, 1375, 1379, 1380, 1382, and 1385. The feasibility study will consider chiller replacement or retrofit and boiler upgrade or replacement. A limited survey of the seven existing buildings served by this plant will be performed to permit a qualitative verification that the existing plant capacities are adequate. The survey will also reveal constraining requirements such as year-round cooling requirements which may influence the recommendations. Chiller replacement/retrofit recommendations will consider refrigerants 123 or 134a only, gas vs. electrical driven compressors, drive configuration (i.e., open-drive vs. hermetic), operating efficiency (i.e, compressor type: screw vs. centrifugal part load and full load capacities and variable speed drive) and maintainability. The cost effects of the new design criteria from the Uniform Mechanical code which requires a partition be provided between the chiller and boiler shall be investigated. As the thermal load history for the plant is not available, a generalized load profile will be assumed and used to analyze the benefits of energy saving options and equipment selections. recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.
- (5) 1300 Area (item 2 must be performed in conjunction with this item). Evaluate Buildings 1350, 1374, 1375, 1379, 1380, 1382 and 1385 and model each building to develop a probable annual thermal load profile. Receive as-built drawings on the buildings from Fort Sam Houston and perform a survey of the buildings to collect information necessary to more accurately develop the annual thermal profile of each. Evaluate the optimum size and configuration for the central plant.
- (6) 900 Area. Evaluate the feasibility and economic impacts of modifying the existing cooling and heating plant in Building 902. This plant provides heating hot water and chilled water to Buildings 902, 904, 905, 906, 907, 908, 916, 917, 919, 920, 921, 922, 924, 925, 926, 928, 929, 930, and 931. The feasibility study will consider chiller replacement or retrofit or refrigerant upgrade and boiler upgrade or modification or replacement. A limited survey of the nineteen existing buildings served by this plant will be performed to permit a qualitative verification that the existing plant capacities are adequate. The survey will also reveal constraining requirements such as year-round cooling requirements which may influence the recommendations. Chiller replacement/retrofit recommendations will consider refrigerants 123 or 134a only, gas vs. electrical

driven compressors, drive configuration (i.e., open-drive vs. hermetic), operating efficiency (i.e., compressor type: screw vs. centrifugal part load and full load capacities and variable speed drive) and maintainability. The cost effects of the new design criteria from the Uniform Mechanical code which requires a partition be provided between the chiller and boiler shall be investigated. As the thermal load history for the plant is not available, a generalized load profile will be assumed and used to analyze the benefits of energy saving options and equipment selections. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.

- (7) 900 Area (item 3 must be performed in conjunction with this item. Evaluate Buildings 902, 904, 905, 906, 907, 908, 916, 917, 919, 920, 921, 922, 924, 925, 926, 928, 929, 930, and 931 and model each building to develop a probable annual thermal load profile. Receive as-built drawings on the buildings from Fort Sam Houston and perform a survey of the buildings to collect information necessary to more accurately develop the annual thermal profile of each. Evaluate the optimum size and configuration for the central plant.
- (8) 100 Area. Review the existing design manual and construction documents prepared in 1986 to provide a central plant at building 250 to serve Buildings 122, 124, 125, 127, 128, 132, 133, 134, 135, 142, 143, 144, 145, 146, 147, 149, 197, 198, 199, and 250. A limited survey of the twenty existing buildings served by this plant will be performed to permit a qualitative verification that the plant capacities established in 1986 are adequate. The survey will also reveal constraining requirements such as year-round cooling requirements which may influence the recommendations. Make recommendations to modify the equipment selections developed with that design and develop a conceptual cost estimate for its implementation. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.
- (9) 100 Area (item 4 must be performed in conjunction with this item). Evaluate Buildings 122, 124, 125, 127, 128, 132, 133, 134, 135, 142, 143, 144, 145, 146, 147, 149, 197, 198, 199, and 250 and model each building to develop a probable annual thermal load profile. Receive as-built drawings on the buildings from Fort Sam Houston and perform a survey of the buildings to collect information necessary to more accurately develop the annual thermal profile of each. Evaluate the optimum size and configuration for the central plant.

- (10) Quadrangle. Evaluate the feasibility and economic impacts of providing a new cooling and heating plant adjacent to the Quadrangle. This plant would provide heating hot water and chilled water to buildings 16, 44, T-56, and 4015. Receive asbuilt drawings on the buildings from Fort Sam Houston and model each building to develop a probable annual thermal load profile. Evaluate the optimum size and configuration for the central plant. Develop recommendations for a central plant configuration and location which will complement the historic nature of the Quadrangle. Evaluate the use of 2-pipe versus 4-pipe thermal distribution. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.
- c. Special Requirements: Distribution of submittal documents are as follows:
 - (1) Three copies of all documents shall be mailed to:

Commander
U.S. Army Engineer District, Fort Worth
819 Taylor Street/P.O. Box 17300
ATTN: CESWF-ED-MR/Champagne
Fort Worth, Texas 76102-0300

(2) Ten copies of all documents, field survey data and one disk shall be mailed to:

Commander
ATTN: AFZG-PW-ESB/Mr. De La Pena
Department of Army
HQ, Fort Sam Houston
Fort Sam Houston, TX 78234

ANNEX B

EXECUTIVE SUMMARY GUIDELINE

- 1. Introduction.
- Building Data (types, number of similar buildings, sizes, etc.)
- 3. Present Energy Consumption of Buildings or Systems Studied.
 - o Total Annual Energy Used.
 - o Source Energy Consumption.

Electricity - KWH, Dollars, BTU
Fuel Oil - GALS, Dollars, BTU, MWH
Natural Gas - THERMS, Dollars, BTU, MWH
Propane - GALS, Dollars, BTU, MWH
Other - QTY, Dollars, BTU, MWH

- 4. Reevaluated Projects Results.
- Energy Conservation Analysis.
 - o ECOs Investigated.
 - o ECOs Recommended.
 - o ECOs Rejected. (Provide economics or reasons)
 - o ECIP Projects Developed. (Provide list)*
 - o Non-ECIP Projects Developed. (Provide list)*
 - o Operational or Policy Change Recommendations.
- * Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date.
- 6. Energy and Cost Savings.
 - o Total Potential Energy and Cost Savings.
 - o Percentage of Energy Conserved.
 - o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

ANNEX C

REQUIRED DD FORM 1391 DATA

To facilitate ECIP project approval, the following supplemental data shall be provided:

- a. In title block clearly identify projects as "ECIP."
- b. Complete description of each item of work to be accomplished including quantity, square footage, etc.
- c. A comprehensive list of buildings, zones, or areas including building numbers, square foot floor ajects.
- (11) Latest MCP Index, essential for projecting costs for project documentation.
- (12) The following items are important and should be provided to the AE to the extent to which they are available:
- (a) As-built drawings of applicable buildings, equipment, or systems
- (b) Handbooks or SOPs relating to the operation of applicable equipment or systems.
 - (c) Applicable records of energy or fuel usage.
- (d) Copies of bills for electrical enetration assumptions before and after improvements.
- (4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.
- e. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.
- f. Lighting retrofit projects must identify number and type of fixtures, and wattage of each fixture being deleted and installed. New lighting shall be only of the level to meet current criteria. Lamp changes in existing fixtures is not considered an ECIP type project.

- g. An ECIP life cycle cost analysis summary sheet as shown in the ECIP Guidance shall be provided for the complete project and for each discrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined shall be included.
- h. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple amortization period and a statement attesting that all buildings and retrofit actions will be in active use throughout the amortization period.
- i. The calendar year in which the cost was calculated shall be clearly shown on the DD Form 1391.
- j. For each temporary building included in a project, separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable and (3) an economic analysis supporting the specific retrofit.
- k. Nonappropriated funded facilities will not be included in an ECIP project without an accompanying statement certifying that utility costs are not reimbursable.
- 1. Any requirements required by ECIP guidance dated 10 Jan 1994 and any revisions thereto. Note that unescalated costs/savings are to be used in the economic analyses.
- m. The five digit category number for all ECIP projects except for Family Housing is 80000. The category code number for Family Housing projects is 71100.

INTERIM SUBMITTAL REVIEW COMMENTS - HO FORSCOM

REVIEW COMMENTS FOR INTERIM SUBMITTAL : EEAP CHILLER AND BOILER PLANT STUDY AT FORT SAM HOUSTON, TX

REVIEWER: NARESH K.KAPUR, P.E. DATED: 6 JULY 95 ORGANIZATION: HQ FORSCOM

ADDARESS: ATTN: AFPI-ENO/KAPUR TEL: 404-669-5327, FAX 7751 BLDG 200,

FORT MCPHERSON, GA 30330-6000

1. THE INTERIM REPORT IS WELL ORGANIZED. IT WOULD BE NICE TO HAVE ONE OR TWO PAGE WRITEUP TO PROVIDE A GIST OF THIS STUDY. SOME OF THE ITEMS TO BE ADDRESSED IN THIS ARE: PURPOSE & SCOPE: ALTERNATIVES CONSIDERED; METHODS OF ANALYSIS AND ASSUMPTIONS; RECOMMENDED ECOS AND THEIR LCC INFO.

- 2. GENERAL. FOR MANY BUILDINGS, LACK OF HVAC CONTROLS LEAD TO OCCUPIED AREAS VERY HOT. REQUEST PROVIDE A SUGGESTED SOLUTION BASED ON YOUR FIELD OBSERVATIONS.
- DISCUSS VARIOUS OPTIONS FOR SELECTING CHILLERS AND GENERAL. BOILERS FOR ECOB. MENTION PROS AND CONS OF EACH, INCLUDING COST FACTORS, ENERGY EFFICIENCIES, POSSIBLE CHILLER WITH INTEGRAL HEATING UNIT, AND EASE OF MAINTENANCE ETC.
- 4. GENERAL. FROM ENVIRONMENTAL CONSIDERATIONS, IT IS DESIRABLE TO AVOID OZONE DEPLETING CHEMICALS (ODC) TYPE REFRIGERENTS FOR NEW CHILLERS. NATURAL GAS ABSORPTION CHILLERS (SEE ENCLOSED INFO) ARE AVAILABLE IN MANY VARIETIES AND USE NON-ODC REFRIGERENT. PL DISCUSS POSSIBILITIES. BY USING NON-ODC REFRIGERENT IN NEW CHILLERS WE CAN POSSIBLY HAVE RECURRING SAVINGS DUE TO SOME AVOIDED MAINTENANCE COST.
- 5. GENERAL. PER YOUR SITE VISIT OBSERVATIONS, MOST OF THE AREAS WERE EXCESSIVELY WARM AND HVAC CONTROLS POOR. HOW DOES THIS AFFECT THE LCC ANALYSIS?
- PG 6. PROVIDE A RECOMMENDED ACTION PLAN TO ADEQUATELY MAINTAIN HVAC SYSTEMS IN VIEW OF EVER DIMINISHING MAINTENANCE PERSONNEL WHO ARE NOT WELL TRAINED.
- 7. GENERAL. IN A CENTRAL PLANT SITUATION, THERE ARE TRANSMISSION LOSSES AND OTHER INHERENT INEFFICIENCIES WHEN THE OCCUPANCY OF BUILDINGS IS NOT UNIFORM. CONSIDER DOING A SAMPLE LCC ANALYSIS CONSIDERING SELECTIVE DECENTRALIZING HEATING AND COOLING EQUIPMENT. IN SMALLER UNITS, WE EXPECT EASIER CONTROLS/ MAINTENANCE. SMALLER UNITS CAN BE SHUTDOWN DURING WEEKENDS/ HOLIDAYS AND NON-WORKING HOURS.
- GENERAL. PL ADDRESS THE FOLLOWINGS:
- A. WHAT ARE DOMESTIC HOT WATER REQUIREMENTS DURING HEATING AND COOLING SEASON? HOW ARE THESE REQUIREMENTS CURRENLY MET? ADDRESS THIS ISSUE IN EACH ALTERNATIVE AS APPROPRIATE.
- B. ARE THERE SIGNIFICANT ENERGY REQUIREMENTS RELATED TO COOKING? PL DISCUSS.
 C. ANY SIGNIFICANT COOLING LOADS DURING HEATING SEASON/
- PL DISCUSS.
- D. PL DISCUSS 4 PIPE V/S 2PIPE SYSTEM AS RELATED TO FT SAM HOUSTON SITUATION.

INTERIM SUBMITTAL REVIEW COMMENTS - USAED MOBILE 7/6/95

MCBILE DIST. OFFICE PROJECT REV	IEN CORMENTS	DATE: 6 July 95	P.3-3 FAGE 1 of 1
TO: Army Corps of Engineers Fort Worth Division	PROM: (Section Review	n): EN-DM er): Robert S. Noo:	iruff
PROJECT: Boiler and Chiller St LOCATION: Fort Sam Houston	udy	Year:	Line Item

Type of Action: Interim Report

tem No.	Drawing No. Or Par. No.	COMOGRALZ	Raview Action
1'.	Page i	The first sentence of the third paragraph should be raworded.	
2.	Page 2 Parz. B.1.	Buildings 915 and 932 should be added to the list of of 900 area buildings studied. The actual study data indicates that these two building were studied (see page C-2).	
3.	Page 2 Para. 5.2.	Building 1377 should be added to the list of 1300 area buildings. This building was part of the actual study (see page C-11).	
4.	Page 5 Perz. 1	The type of refrigerant used in each of the chillers serving the quadrangle buildings should be listed.	
5.	General	The operating schedules used in the Trace studies appear to be reasonable. It should be pointed out in the study report that if the existing controls were repaired and set properly the energy savings would be even greater than those predicted by the study.	
6.	General	The replacement chiller for the 1300 area appears very close to meeting the criteria for approval. Are there any ways that this SCO could be modified to make it feasible?	

INTERIM SUBMITTAL REVIEW COMMENTS - FORT SAM HOUSTON, TX

<u></u>			7/10/95				
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INTERIM SUBMITTAL REVIEW COMMENTS - FORT SAM HOUSTON, TX 7/10/95

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RESPONSES TO INTERIM SUBMITTAL REVIEW COMMENTS 7/10/95

A. FORSCOM Comments:

- 1. Executive summary in final report will summarize the study as requested.
- Additional maintenance recommendations will be added to study which will address the repair of HVAC controls in the buildings.
- 3. Additional text will be added which will describe the selection of new equipment to be used in the analysis in this study.
- 4. Gas absorption cooling systems would eliminate the concerns over refrigerant types to be used in the new chillers. However, analysis of these types of cooling systems is beyond the scope of this study. (See pages F-11 through F-15)
- 5. An underlying assumption in all ECOs in this study is that the building controls remain as-is, and the new central cooling and heating systems merely save central plant heating and cooling energy, rather than improve building temperature control. Therefore, the LCC analysis of each ECO is valid whether the building HVAC controls are repaired or not. However, it is acknowledged that additional energy savings are possible if these controls are repaired. But analysis of these savings is beyond the scope of this study. (See pages F-11 through F-15)
- 6. An underlying assumption in the maintenance and operations recommendations made in this study is that the installation has adequate resources to implement them. It is beyond the scope of this study to determine the installations maintenance capabilities and provide maintenance strategies based on them.
- 7. Because of the apparent shortage of HVAC maintenance manpower at this installation, it is felt that centralization of the primary heating and cooling equipment is the best strategy to pursue. Consideration of unitized primary heating and cooling equipment is beyond the scope of this study. (See pages F-11 through F-15)
- 8(A). Descriptions of all domestic hot water heating systems can be found in the building data sheets in Appendix C. All DHW systems, except for the 900 area, are unitized by building, and separate from the heating system. It is assumed that DHW demand is directly related to building occupancy rather than outside weather conditions. In area 900, the DHW demand used in the study was taken from a 12 month metered gas profile for building 902. This amounted to boiler base load of 565 BTUH, as described on page B-3, item E (5). This load was constant throughout the year, due to the nearly constant occupancy of the barracks buildings in the 900 area.
- 8(B). Only buildings 1377 and 2265 have small boilers which are used for cooking loads. These cooking energy demands were assumed to be small as compared to the heating and cooling demands of all buildings in the study. Therefore, any ECO performed on these cooking boilers would have very long paybacks of greater than 10 years.
- 8(C). Because of the physical size of the buildings studied, and the types of internal heat sources present within them, the only significant cooling loads possible during the heating season would be in areas which house central computer equipment. The areas which fit this description were

generally served by unitary cooling equipment which could operate independently of the central HVAC systems, therefore providing cooling during the heating season if required. Building 2263 however has large computer areas without unitized cooling systems. In almost all cases, the analyst feels that the lack of operable HVAC controls along with the apparent over sizing of the central boiler systems is the cause of the high temperatures within the buildings during the heating season. However, operable windows are available in many cases to offset the lack of temperature controls.

8(D). The evaluation of two-pipe vs. Four-pipe systems at the installation was determined by the contracting officer to be beyond the scope of this study. Therefore, it was omitted.

B. MOBILE

- 1. Sentence reworded as requested.
- 2. Buildings added to list as requested.
- 3. Building added to list as requested.
- 4. Refrigeration types added to description as requested.
- 5. Statement added to Maintenance & Operations Recommendations as requested.
- 6. The area 1300 chiller replacement (ECO-C) was reevaluated, leaving the 1983 chiller in place and only replacing the two 1972 chillers with a single new chiller. The new payback is 8.4 years and this ECO is now recommended.

C. FORT SAM HOUSTON

- Over sizing of the new boiler and chiller equipment in the study would cause the ECO paybacks to be over 10 years and therefore unacceptable. Therefore, new equipment was sized to closely match the heating and cooling load profiles given in Appendix B.
- 2. ECO-G, the central chiller plant for the Quadrangle area, was evaluated to have a 20.9 year payback and was therefore not recommended for implementation. Increasing the implementation cost of this ECO by adding funds for architectural aesthetics would not improve the payback time. Therefore, no changes were made to this ECO.
- 3. Words replaced as requested.

 $\begin{array}{c} \text{APPENDIX G} \\ \\ \text{SAMPLE PRODUCTS} \end{array}$

APPENDIX G SAMPLE PRODUCTS

TABLE OF CONTENTS

Maintenance Cost Estimate Data	G-1
Chiller Retrofit Cost Data For R-11 To HCFC-123 Upgrades	G-3
York International Data On Chiller Performance	G-5
Aerco International Data On Modular Boiler Performance	G- 9
Area 100 New Central Boiler Data	3-12

DYNASERVICE

RECEIVED

MAR 0 1 1995

HZ

FEBRUARY 27, 1995

MR. WALTER WILLIAMS, III P.E. HUITT-ZOLLARS, INC. 512 MAIN STREET SUIT 1500 FORT WORTH, TX 76102

Walter,

I have projected maintenance cost for equipment you have noted broken down to per unit per visit on AHU, FCU, Fans, etc. Recommended at four (4) visits per year normal conditions. Severe conditions may require more frequent visits. To obtain heating and cooling season costs just divide visits in half and omit items such as water heater and exhaust fans if you do not want them included in heating and cooling costs.

NOTES: Boilers: one (1) visit per year annual inspection Chillers: four (4) visits per year. Three (3) routine checks and one (1) annual winter

service.

GeoTherm Wells: not applicable Cooling Towers: one (1) visit per year complete

annual clean and service

*Annual switch from heat to cool is per season per building.

817.589 0200

A DIVISION OF

CORPORATION
7466 Dogwood Par-

DYNA TEN

Fort Worth
Texas 76118

817.595.4433

817.589 9911

Metro

Attached list shows breakdown of costs. If you have any questions, please call.

Sincerely,

David J. Recca

Customer Relations &

Sales

DR/als huitt

DYNASERVICE

PAGE FOUR OF FIVE HUITT ZOLLARS PAGE THREE OF BREAKDOWN PREVENTIVE MAINTENANCE

B. CENTRAL PLANT EQUIPMENT

1. Cooling Equipment

All of the below alternatives include a new chilled water pump (25 hp) and cooling tower.

a.	Existing Chiller retrofit to R-123	
	refrigerant, includes checking room sensors*	\$2275/yr
b.	New Water Cooled Centrifugal Chiller R-22*	\$2275/yr
c.	New Water Cooled Centrifugal Chiller R-123*	\$2275/yr
d.	New Water Cooled Centrifugal Chiller R-134A*	\$2275/yr
e.	New Water Cooled Screw Chiller*	\$2275/yr
f.	New Water Cooled Centrifugal Chiller with	
	VFD Compressor motor and inlet vanes*	\$2275/yr
g.	New Engine Driven Chiller - Natural Gas fired	
	combustion engine. Similar to York CAT engine	
	drive chiller. Jacket water will be utilized to	
	heat domestic hot water during the summer months*	\$3075/yr
*Oi	il test only, no oil change	

All of the below alternatives include a new chilled water pump (25 hp)

b. New airc. Chilled	cooled reciprocating chiller* cooled screw chiller* Water Pump (25 hp) O ton size equipment	\$2250/yr \$2250/yr \$25**
**ber Arei	L	

2. Heating Equipment

All of the below alternatives include a new heating water pump (20 hp)

a. New standard firetube boilersb. New vertical fired high efficiency	2	\$475*
firetube boilers	4	\$475*
c. New cast iron boilers	2	\$475*
<pre>d. Hot water pump (20 hp) *One visit per year. **Price per visit.</pre>		\$25**



39 Olympia Avenue - Woburn, MA 01801-2073 USA Telephone: (617) 935-9050 - Telefax: (617) 935-9052 Telex: 455328 NOR RES WOB UD

June 16, 1995

Mr. John Carter Huitt-Zollars 512 Main Street, Suite 1500 Forth Worth, TX 76102 Post-it Fax Note 7671 Date 6/16 1301 4

The folia Caster From James Tang

State 3 17 335-1025 547-935-905

Dear Mr. Carter:

We are pleased to provide our Preliminary and Budgetary Quotation No. 950-2361 describing the design and manufacture of replacement impellers for returning original capacity to various chillers described in your fax of June 14, 1995.

Based on our past experience, we believe that any capacity loss resulting from the conversion from CFC-11 refrigerant to HCFC-123 can be rectified by changing the impellers. This option will retain original operating conditions, including driving speed, and will avoid the need to change other system components such as the condenser. This presumes that the evaporator and condenser are adequately sized for the added HCFC-123 flow rates.

NREC proposes to design and supply new compressor impellers which will provide the pressure ratios and flow rates required by the use of the new refrigerant. NREC predicts that the present capacity of the systems using CFC-11 can be achieved using our high performance impellers with negligible increases in power consumption. However, we reserve the possibility of up to a 5 percent increase in power consumption.

This proposal assumes that we will work with a contractor of Hultt-Zollars's choice to perform the entire conversion of the machines for the customer. NREC will be responsible for:

- · measuring compressor internals,
- designing and fabricating new impellers,
- balancing the impellers.
- supporting the contractor during the installation, conversion, completion, and operational testing of the converted system.

The selected contractor would be responsible for:

- · removing and reinstalling the impeller,
- providing all other on-site support and conversion tasks.

NREC will retain overall responsibility for the satisfaction of the performance requirements. The impellers will be designed and manufactured to operate within the

Mr. John Carter June 16, 1995 Page 2

specified original equipment. The impellers will be individually balanced, spin-tested, and assembled to the original rotor shaft.

Listed below are the preliminary and budgetary prices for the chillers you outlined in your request:

Area:	900	2200	1300	1350
Manufacturer:	York	Chrysler	Trane	Carrier
Make: Model: Quantity: Budget Price:	TurboPak HT YTC3D3C1CJC One (1) \$175,000	Airtemp C2MN7792 One (1) \$250,000	Centravac PCV5FC1D1 Two (2) \$275,000	19DK7894CP One (1) \$35,000

Since NREC have not yet designed impellers for the specific York, Chrysler, and Trane compressors above, a significant non-recurring engineering and tooling effort is included in the budget price. NREC is currently evaluating market potentials and, within six months, may develop a design and production plan for the York TurboPak and Trane Centravac chillers. This new position could possibly reduce the costs for the replacement TurboPak and Centravac impellers.

This proposal is subject to the standard "Products Sales" Terms and Conditions of our parent company, Ingersoil-Rand. A copy of these Terms and Conditions is attached. If you have any questions about the quotation, please feel free to contact me at (617) 937-4668 or Mel Mittnick, Senior Applications Engineer, at (617) 937-4855.

Sincerely,

NORTHERN RESEARCH AND ENGINEERING CORPORATION

Chi-Wu (dimmy) Tang Sales Engineer

CJT/ph Enclosure

2361HUIT.DOC

CHILLER STUDY FT. SAM HOUSTON

Prepared For:
Mr. John T. Carter
HUITT-ZOLLARS, INC.
512 Main Street
Suite 1500
Ft. Worth, Texas 76102
Project # 03-0185-04

Prepared By:

TOM McGREAL YORK INTERNATIONAL 12901 Nicholson Road #260 Dallas, Texas 75234 (214) 620-8830

February 2, 1995

1,1

G-5

February 2, 1995

Huitt-Zollars, Inc. 512 Main Street **Suite 1500** Ft. Worth, Texas 76102

Attention: Mr. John T. Carter

Re: Chiller Study - Ft. Sam Houston Huitt-Zollars Project 03-0185-04

Dear John,

Per your request, we are pleased to provide you with the following information concerning the study you are doing on the above referenced project:

Overview

900 Area

Served by (1) - 300 ton R-11 York YT Model

1300 Area

Served by (2)-500 ton R-11 chillers and (1)-440 ton R-11 Chiller

Some initial thoughts about the existing chillers:

Since the York chiller serving the 900 Area is "open" drive, it can be retrofitted quite inexpensively to R-123 (cost of approximately \$20,000). However, there will be a tonnage deration and loss of efficiency (see attached chiller rating).

The units serving the 1300 Area will be hermetic chillers, and converting them to R-123 would be cost prohibitive, as the units would require total motor rework to become compatible with R-123. Replacement may be the only solution for this area, with the only exception being York "Codekits", new Open Drive Motor/Compressor Assemblies, field mounted. If the shells and tubes are in good shape, this option may make some sense.

For the energy evaluation of electric centrifugal chiller full and part load performance, the curve you have will be excellent for the centrifugal chillers. As a baseline for full load efficiencies, use the following:

R-123 Model YT Tonnage Range 150 - 800 tons

150 - 250 tons use .62 KW/Ton

250 - 350 tons use .59 KW/Ton

350 - 675 tons use .56 KW/Ton

675 - 800 tons use .58 KW/Ton

R-22 Model YK Tonnage Range 350 - 2100 Tons

350 - 600 tons use .62 KW/Ton

600 - 1200 tons use .58 KW/Ton

1200 - 1700 tons use .60 KW/Ton

1700 - 2000 tons use .62 KW/Ton

12901 Nicholson, Suite 260, Dallas, Texas 75234 Telephone (214) 620-8830 • Fax (214) 484-7689



CORPORATION

Huitt-Zollars Ft. Sam Houston Project Page 2

R-134a Model YK Tonnage Range 350 - 2100 Tons

350 - 600 tons use .62 KW/Ton 600 - 1200 tons use .58 KW/Ton 1200 - 1700 tons use .60 KW/Ton 1700 - 2000 tons use .62 KW/Ton

For the Gas Engine Drive Chillers, utilize the R-134a selections (only refrigerant available on CAT Engine Drive Chillers), and use the following:

R-134a Model YG Tonnage Range 400 - 2100 Tons 6.6 MBH per ton (full load) from 350 - 700 Tons 6.2 MBH per ton (full load) above that

The part load curve will be slightly better than the centrifugal curve, but it will conservatively show the savings offered by gas.

- For the Water Cooled Screw Chillers, the part load curve will also be slightly better than the centrifugal, particularly through the 25% to 50% range. I've attached a "Marked Up" art load curve which should be used for the screw chillers. The full load efficiency base line should be:

R-22 Model YS Tonnage Range 125 - 675 tons, 1000 - 1200 tons

125 - 200 tons use .64 KW/Ton 200 - 280 tons use .62 KW/Ton 280 - 375 tons use .62 KW/Ton 375 - 675 tons use .64 KW/Ton

- For Air Cooled and Water Cooled Reciprocating Chillers, the full and part load points are attached.
- For the Gas Fired Absorption Chillers, utilize the attached curve and 12 MBH per ton for full load energy consumption.

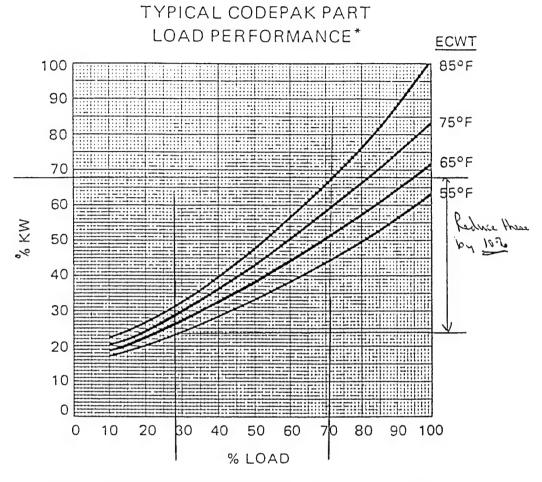
We appreciate your interest in York products. Please feel free to call me if you have any questions.

Cincordly

Thomas J. McGreal Systems Consultant

C.\WPWIN60\TOM\SAMHQUST

Water Course Sure a Chailer



^{*}Based on 2.4 GPM/Ton of 44°F leaving chilled water temperature; 3 GPM/Ton of condenser water; 0.0005 FF on both circuits.;

13

G-8



MODEL KC-1000 GWB

TECHNICAL DATA

AERCO KC Gas Fired Hot Water Boiler System

The AERCO KC Water Boiler is a true industry advance that meets the needs of today's energy and environmental concerns. Designed for application in any closed loop hydronic system, it relates energy input directly to fluctuating system load, yielding seasonal efficiencies as high as 95%. The boiler can be used singly or in modular arrangements for inherent standby with minimum space requirements. Venting flexibility permits installation without normal restrictions.



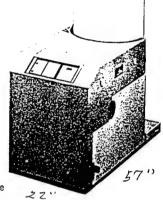
The advanced electronics of each boiler module offer selectable modes of operation. The options available include:

AERCO

Constant Temperature Internal Setpoint Indoor/Outdoor Reset 4-20ma Linear Signal Response AERCO Boiler Management System Integration AERCO Combination Domestic Water/Boiler Plant

Regardless of the mode of operation, the load tracking capability of every unit delivers the ultimate in energy control through energy input modulation with a 14:1 ratio while meeting all load demands.

With condensing capability, the KC Boiler is ideally suited for modern low temperature as well as conventional heating systems. Because of the compact design with direct or conventional venting, the KC Boiler system is applicable to either new construction or retrofit application with the same excellent results. Efficiently, reliability, and longevity make the KC Boiler System a true step forward in heating system design.



25 GPM

KC1000 FEATURES

- Natural Gas or Propane
- 14:1 Turndown Ratio
- Direct Vent or Conventional Vent Capabilities
- ASME 150 PSIG Working Pressure Certified
- UL, ULC Listed, FM Approved, ASME Coded
- UL, ULC Listed for Alcove Installation on Combustible Flooring
- Quiet Operation throughout Firing Range
- Internal Low Water Cutoff and Dual Over Temperature Protection
- · Compact Space Efficient Design
- Precise Temperature Control +/- 2F
- Optional Sealed Combustion

KC-1000 Specifications

BTU Input	1,000,000 BTU/Hr†
Net Output @ full input	860,000-915,000 BTU/Hp*
ASME Working Pressure	150 PSIG
Electrical Requirement	120/1/60 20 Amp
Gas Requirements8	3.5" W.C. Minimum @Full Load 14" W.C. Maximum
Vent Size	6* Diameter
Water Connections	4" Flanged 150 lb. ANSI
Gas Connection	1-1/4" NPT

**************************************	23 GI W
Maximum Water Flow	150 GPM
Water Pressure Drop	0.23 Ft. 100 GPM
Water Volume	23 Gallons
Control Range	50F to 220F
Standard Listings & Approvals	UL, ULC, FM, ASME
Optional Approval	IRI
Weight, Installed	1200 lbs.

*Output is dependent upon return water temp, and firing ratesee efficiency curves on reverse. †Up to 2000 Altitude.









Minimum Water Flow

FEB-15-'95 WED 09:47 ID:NEAL ASSOCIATES TEL NO:214 AERCO INTERNATIONAL INC. KC HEATING BOILERS TEL NO:214 340 7767

PERFORMANCE COMPARISON

^ase Date: Feb 13, 1995

.oject Name: BOILER JOB 1

Rep Firm: Salesperson:

AERCO International, Inc.

Javier Piraneque

Design Firm:

Design Information:

Facility: MILITARY BASE Square Footage: 000 BIN City Data: DALLAS

Competition: BURNHAM FIRETUBE Its Max Known Thermal Effy:80.0%

Design Heat Loss 2,500,000 BTU/H TYDICAL Outdoor Design Temp: 10 F Temp Differential: 20 F FOR ANY LOAD.

50,817 EU 25,232 EU

Supply Water Temp @ Design:180 F Indoor Design Temp: 70 F # of KC-1000 Boilers: 3 With an Efficiency of 86.2%

Energy Units Consumption

TOTALS:

10

Fuel Consumed: Natural Gas

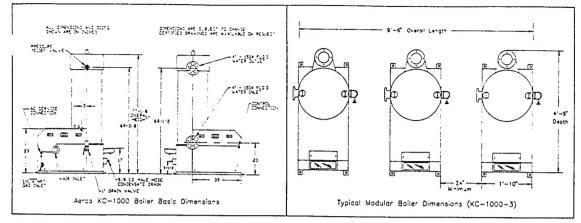
Outdoor AirTemp 70 65 60 55 50 45 40 35 30 25 20	ASHRAE BIN Hours 1,400 1,200 1,000 900 800 770 499 350 250 150 59	BURNHAM Effy % 50.0 52.5 55.0 57.5 60.0 62.5 65.0 67.5 70.0 72.5 75.0	FIRETUBE Energy 0 4,762 7,576 9,783 11,111 12,833 9,596 7,562 5,952 3,879 1,639 887	AERCO B Effy \$ 93.0 99.7 99.5 98.9 97.9 91.0 89.6 89.0 88.8 86.8 86.5	oilers Energy 2,509 4,191 5,692 6,816 8,550 6,861 5,699 4,682 3,168 1,417 796	Difference Energy Units 0 2,253 3,385 4,091 4,295 4,284 2,735 1,863 1,271 711 221 91
15 10						221 91 33

lf BURNHAM FIRETUBE equipment is selected for this project, the INCREASE in energy usage over Aerco International KC Boilers will be approximately 49.7% MORE per year.

76,049 EU

AERCO International reserves the right to revise any information contained within this program in accordance to the written legal agreement as stated in the pages of our users manual dated 5/94

Dimensions KC-1000 Boiler



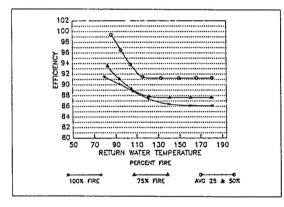
Ratings and Dimensions

Modules	Model	Mbh Input	MBH Output	Length	Depth	Height	Weight	
	(a)	(b)	(b) (c)					
One (1)	KC-1000	1000mbh	860mbh-915mbh	1'10"	4'9"	6′8″	1200lbs.	
Two (2)	KC-1000-2	2000mbh	1720mbh-1830mbh	5′10″	4'9"	6′8″	2400lbs	
Three (3)	KC-1000-3	3000mbh	2580mbh-2745mbh	9'8"	4'9"	6'8"	3600lbs	
Four (4)	KC-1000-4	4000mbh	3440mbh-3660mbh	13'6"	4'9"	6'8"	4800lbs	
Five (5)	KC-1000-5	5000mbh	4300mbh-4575mbh	17'4"	4'9"	6′8″	6000lbs	
Six (6)	KC-1000-6	6000mbh	5160mbh-5490mbh	21'2"	4'9"	6'8"	7200lbs. 8400lbs. 9600lbs.	
Seven (7)	KC-1000-7	7000mbh	6020mbh-6405mbh	25'	4'9"	6'8"		
light (8)	KC-1000-8	8000mbh	6880mbh-7320mbh	28'10"	4'9"	6′8″		

(a) Style to be Determined by Individual Application Requirement

(b) Altitude below 2,000', Apply Altitude Correction Factor above 2,000. (c) Output dependent upon application-see efficiency curves.

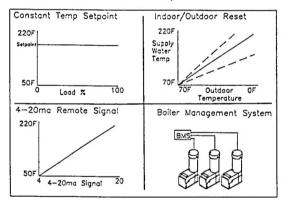
Efficiency Curves



Represented by:

GFB-1 BBC 08/93 5M

Programmable Modes of Operation



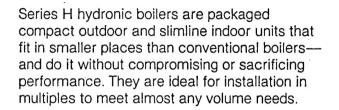
HEAT EXCHANGES • WATER HEATERS • BOILERS
CONTROL VALVES • STEAM GENERATORS

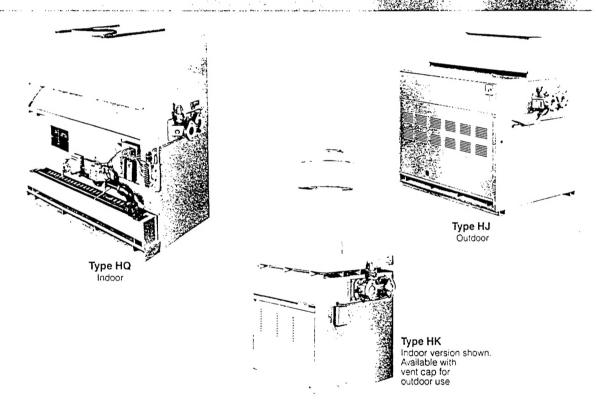


HOT WATER SYSTEMS

AERCO INTERNATIONAL, INC. • 159 PARIS AVE., P.O. BOX 128 NORTHVALE, N.J. 07647-0128 • (201) 768-2400 • FAX 201-768-7789

Hydronic Boilers





**TELEDYNE LAARS

Dimensions and Technical Data

Series H copper tube hydronic boilers are designed for closed system heating applications. All models are design-certified by AGA for natural or propane gas. Note: Two-stage with outdoor reset available.

	Boiler Ratings' Natural & Propane Gas			Gas Connection ⁴					Dimensions'—see drawings below									
16	BTU Input x 1000	BTU Output x 1000 Indoor	BTU Output x 1000 Outdoor	Mechanical Modulation				Motorized Modulation	Air ³ Supply					v	Indoor Draft Hood	Outdoor Vent Cap	Water Piping Conn.	Ship- ping Wt.
	A 1000			Nat.	Pro.	Nat.	Pro.	Nat.	(Sq. Ft.)	A	В	С	D	(Dia.)		н		
250	250	200	188	3/4	1/2	-	_	_	.5	221/2	32%	151/4	113/4	7	27	23	2	251
325	325	260	244	3/4	1/2	-	_	_	.6	26 3/4	36%	17%	113/4	8	273/4	23%	2	316
400	400	320	300	3/4	1/2	-	_	-	.8	31 3/4	41%	20%	113/4	9	29 1/4	261/4	2	371
500	500	400	375	_	-	1	3/4	1	.9	30%	361/2	20	6	10	_	_	2	407
625	625	500	469		_	1	3/4	1	1.0	361/2	42%	23	7	12	_	_	2	562
750	750	600	563		-	1	3/4	11/4	1.3	42%	481/4	25%	8	14	_	_	2	6 03
925	925	740	694	_	_	1	1	11/4	1.6	50%	56 1/2	30	8	14	_	_	2	798
1100	1100	880	825	-	-	11/4	1	11/4	1.9	58%	64%	34%	9	16	_	_	21/2	863
1266	1266	1013	950	_	-	1 1/4	1	1 1/2	2.0	66%	721/2	38	9	16	_	-	21/2	933
1466	1466	1173	1100		-	11/4	11/4	1 1/2	2.5	76	81%	423/4	10	18	_	_	21/2	1004
1666	1666	1333	1250	_	_	11/4	11/4	11/2	2.9	851/2	911/4	47%	10	18	_	_	21/2	1146

Boiler standard with 2-stage firing on Models 500 through 1666.

Notes:

- All dimensions nominal. Dimensions not shown in table are given in drawings below. Where measurements are critical request certified drawing.

 The design of all models has been certified by AGA for natural and propane gases.

 All models conform to ASME Boiler Code for 160 PSI working passive. working pressure.

 Derate propane ratings for outdoor boilers by 10%.

Derate BTU input and output 4% for every 1000 ft installation is above sea level. No derating necessary up to 2000 ft. elevation. Ex. At 4000 ft. elevation derate BTU input and output 16%. For other boiler ratings:

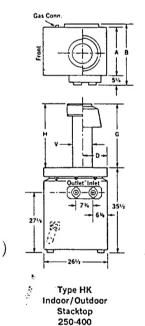
IBR Net BTU) = Output 1.15

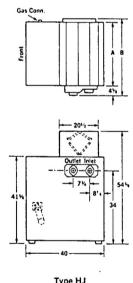
EDR (So. Et.) = Output

EDR (Sq. Ft.) = $\frac{0.13}{150}$ IBR (Sq. Ft.) = Net IBR BTU

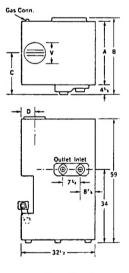
- 3. Area indicated is for each of two openings, one at floor and one at ceiting, communicating directly through a wall to outside air. For all other condition: refer to American National Standards Bulletin Z223.1—1974 Section 1.3.4.
 Check touver manufacturers for Net Free Area of louver. Correct screen resistance to net Free Area screen used.

 4. Size shown is the connection at the boiler. For correct sizing of the gas supply piping and gas supply pressure see Document 1010.









Type HQ-Slimline Integral Draft Hood Indoor Only 500-1666